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PEOPLE who have not visited Washington are most familiar with the east front of the Capitol, because this is the view most often selected by photographers, and in certain ways exhibits a more complete design than that to be found on the western front. It has generally been understood that the western front was not quite finished, but what more was to be done to it seemed less clear, and the long flights of steps and somewhat abrupt earth terraces have remained for years as a rather unsatisfactory introduction to the great building above. About three years ago, however, a plan for finishing this front was arranged, and after the usual manœuvring adopted, and according to the habitual governmental practice an appropriation was secured for beginning the work on the lines indicated. As the changes were to be accomplished less by alterations or additions to the structure of the Capitol itself than by subsidiary improvements wrought in the grounds beyond the wall of the Capitol, it was not unreasonable that the design and its execution should be placed in the hands of a landscape architect, the one selected being Mr. F. L. Olmsted. The scheme adopted by this gentleman was, roughly speaking, to surround the Capitol on the north, west and south by a marble terrace wall in two levels, which should at once serve as retaining-walls, and so give some actual added security to the foundations of the Capitol, and likewise should, from certain points of view, have the semblance of a needed sub-basement on those sides of the building, and so enhance the architectural effect of the building as seen from Pennsylvania and Maryland Avenues; the architectural effect being heightened by the broad flights of steps, parapets, balustrades, and so on, introduced for that purpose only. But the plan provided for the actual enlargement of the building, by including below the terrace walks, and between the terrace wall and the basement rooms of the Capitol, some ninety compartments or rooms which could be used for one purpose or another, if for nothing more than for the storage of documents, coal and supplies, and for workshops of one kind or another, the removal of which thither from the main building would make rooms in it available for administrative purposes, to the great advantage of members of Congress and their underlings, who are now cramped for space. For nearly three years the work has gone on, and the terraces on the north are finished and work on other portions has begun; so that members of Congress and others can now form an idea of what the final effect is to be.

EACH year an appropriation for the fiscal year has been obtained for the work with more or less difficulty, until this year the difficulty has become a serious one and has resulted in the loss, if we understand the language of the *Congressional Record*, of the reappropriation of the unexpended balance of last year's appropriation. The trouble is this: it seems that members of the Committee on Appropriation and others understood that the new works would afford ample space for new committee-rooms of which there is much need, and their votes were given on this understanding. The plans showed many rooms; they knew the work was above the present level of the ground, and not being accustomed to the interpretation of drawings they may be excused for supposing that these rooms would have windows. When the northern terrace showed a solid marble wall they naturally asked where were the windows, and were told more or less authoritatively that windows exposed to northern light would be of no great use, but that when work was begun on the sides where sunlight could be of avail there windows would be found. But enough work has been done on these more favorable exposures to assure the anxious seekers for airy and well-lighted committee-rooms that the new works are intended to embrace none such, and that if committee-rooms there are to be they are to be furnished mainly with forced ventilation and artificial light, aided by such daylight as may come through dead-lights in the terrace walk above: although there are some few rooms which will receive indirect air and light by opening onto a small area, which is to be enclosed and treated as a winter-garden. Naturally the self-deceived or misled Congressmen wish to call a halt and stop the supplies till they can compel Mr. Olmsted to cut windows in his terrace walls, and give them the outer air and light they crave; and they scoff at all arguments based on the architectural fitness of things, and take the opportunity to cast many slurs on the architectural profession. Mr. Olmsted and his backers defend the work by showing that neither the plan nor the perspective drawing of the improvements, which for a long time before its adoption hung on the walls of the Capitol, showed any windows whatever. And they plead that to cut windows in the terrace wall would be to weaken or wholly nullify the chief object had in view in the preparation of the design, that is the providing for the Capitol an apparently supporting base of adequate proportion and massiveness. They lay stress, too, on the fact that the removal of the contents and occupants from the old rooms to the new will make possible such redistribution of space that committee-rooms can be found in the old building itself.

WERE it not for the present removal of the Congressional Library and its dependencies to the new building, and the probable though much more remote transference of the courts and law library to a similar building, which will put at the disposal of the Houses of Congress a very large space, which they can absorb for their own needs, we should side unhesitatingly with those who demand light and air. In the halls of Congress members have now to suffer the evils of imperfect light and ventilation, and it seems most unwise, when carrying out what is practically an enlargement of the building itself, to repeat the original error of excluding natural light and air, and renew evils needlessly, which in the older structure it has taken much ingenuity, time, and money to even partially cure. In the first place, even if the new terraces were actually and avowedly a basement for the Capitol, we believe that it would be practicable to introduce windows enough to satisfy the demand of the objectors without in any way weakening the effect it is desired to achieve. We believe that under the present conditions the result would be still more practicable, since the terrace must, to a considerable extent, count as a separate structure, except from some few points of view, and that it could be treated as such without doing violence to its character of retaining-wall to the building above. No scale is attached to the drawings before us, but the wall of the terrace seems to be at least forty feet in front of the walls of the Capitol, and to be from twenty to thirty feet high, and these dimensions seem to indicate that, except in orthographic projection on a drawing-board, the windows demanded might be safely introduced either in Mr. Olmsted's design or in some other equally well suited to the situation. It is not surprising that a landscape architect, whose instincts and predilections are above all things æsthetic, and in whose professional life the severely practical is never dissociated from the beautiful should feel that merely utilitarian needs must yield before considerations of artistic propriety. It seems to us as if he must begin to conceive of his results at the point at which the architect leaves off; that is, that he pictures to himself the result he wishes to achieve and compels the practical conditions to fit themselves to his intention; while the architect begins with the practical

requirements and does not lose sight of them in working out as æsthetic an embodiment as circumstance will admit. In the present case we do not imagine that such an artist as Mr. Olmsted has deceived himself as to the result he will obtain, and we believe that the terraces will form a satisfactory and dignified base to the Capitol. Still, as a structure enclosing above the level of the ground some ninety rooms, used more or less as work-rooms, we cannot but feel that, architecturally speaking, the terraces are a sham, and that for purposes of landscape architecture simple retaining-walls would have been sufficient. If, however, it can be conclusively shown that no openings can be made without doing injury to the Capitol, let us put up with one more sham, and beg our Congressmen, in the name of high art, to bear as patiently these new inconveniences as the ones they already endure.

IT would seem that by this time Americans would have become so accustomed to having American engineers accomplish seeming impossibilities that less opposition would be made by the uninstructed public whenever there was question of carrying out operations which, if successful, must unquestionably be of great benefit to every one. But property-holders are apt to look at matters from purely selfish standpoints, and where the failure of the operations would entail on them individual loss, it is not unreasonable that they should decline, as the Broadway property-holders have, to take an unequal risk for the benefit of the general public. The Arcade Railway, under the authorization of the law passed last May, seemed likely to be built at last, and the Company is said to have been successfully getting together its three million dollars of paid-up capital and its two million dollar indemnity-bond, which the charter of the road compelled it to provide before actual work had been begun. Meanwhile, the property-holders on Broadway, representing, it is said, over sixteen and a half million dollars' worth of real estate, held in fee simple, have organized themselves in opposition, and have obtained from Judge Barrett an injunction against the Arcade Railway Company, which they propose to serve on the Company in case actual operations should ever be begun. The grounds on which the injunction is granted include, of course, pleas that the law passed in May last is unconstitutional, that the Company's charter has expired, is defective, or does not cover the work which is in contemplation, and various other legal objections which do not concern us. The plea that the tunnel would interfere with existing vaults and cellars built out under the street can probably be met by showing that these structures have no legal right to penetrate beyond the curb-line. The possibility of excavating without imperilling the safety of existing buildings is a serious question, but the experience of the London underground railways, and the testimony of competent engineers, gives assurance of the entire practicability of the operation, and the question turns simply on whether the Company will prove to have sufficient financial strength to carry on the building of the tunnel, and the underpinning of such structures as may need it; but this is a mere matter of finance, and we believe the Company would be able to surmount this difficulty. The charge that the work would be a serious interference to traffic, sounds as if the objectors expected that the whole length of Broadway would be opened, from end to end at the same time, whereas the entire work would probably be conducted from two or three headings, and the excavated material taken down the side streets to barges, or up the other avenues out of the city. One of the most startling charges is that the entire amount of the indemnity-bond, two million dollars, would not be enough to indemnify the city itself for the damage done to its sewers along a single mile of Broadway. We hope that it will not be possible to prevent the execution of what we consider to be the most important public work which can be carried out in New York City. We call it so, because we feel that through it the traffic of Broadway will be revolutionized, and so bring about the reconstruction of a large portion of the older buildings which now line the street on either side much more speedily than would be the case in the natural order of things. This change, and the consequent increase of building operations, would begin almost immediately, as the undermining would probably affect the older and less well built, even if lighter, buildings quite as much as the more modern ones, and the owners, finding that new substructures were being provided for them, would see the advantage of joining hands with the Company, and making the new substructure substantial enough to serve as the foundations of wholly new buildings to be built forthwith.

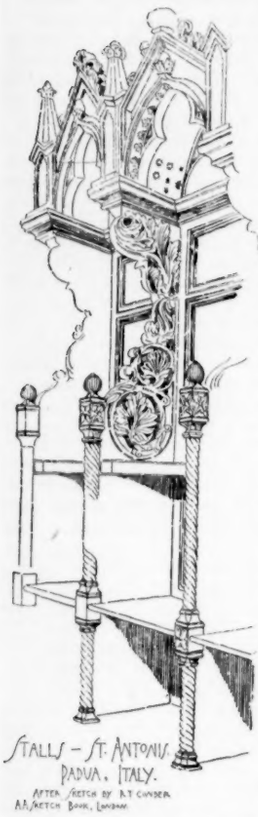
MANY a sympathetic ache has the observer experienced on beholding some of our remarkable public statues, and has devoutly wished that General Jackson, in Washington, could slacken his rein enough to let his rampant rocking-horse come down on his fore feet for just a moment, or that the General himself could unbend enough to give his cocked hat a final flourish and put it on his head; that Edward Everett in the Boston Public Garden could for one moment cease to be a dancing dervish, and put that uplifted hand into his pocket, or that any of the myriad figures just starting into action would for once follow the example of Don Pedro in the opera and complete what they have for so many years been trying to do. One weary master-piece has set an example which others would do well to follow, and having tired itself, the beholder and its support has tumbled to the ground and broken its neck. Last week the bronze statue of Dr. Horace Wells fell from its pedestal in Bushnell Park, at Hartford, through the decaying of the wooden pedestal which had supported it ever since its erection. We do not know the statue, so we do not know whether to repine that misfortune has fallen on a work of art, or rejoice because a special dispensation of Providence has overtaken a work of not-art. The fact that the statue was erected in memory of one of the claimants of the honor of having discovered the virtues of sulphuric ether as an anæsthetic recalls Dr. Holmes's advice when the matter of erecting in Boston a monument to Dr. Morton, the other claimant of the discovery, was under discussion. Referring to the uncertainty whether Dr. Morton or Dr. Wells had the better claim, he suggested that the monument should be a stone pedestal, bearing on one side the name or figure of Dr. Morton and on the opposite side that of Dr. Wells, while on the remaining sides of the die should appear the simple inscription "To ether."

THE National Academy has the reputation of doing many extraordinary and high-handed things, but, if reports are true, it has excelled itself in the treatment of a French artist of some repute, M. Bel, whose painting at last winter's exhibition was most discourteously skied. M. Bel gave himself the trouble to inquire why he had been so treated, and received an official letter which stated that, as he had evidently only sent his picture to the exhibition to escape the payment of the customs dues, he could not expect to be treated with the consideration shown to Americans, for whose protection the high-art tariff is maintained. How any body of men, if this tale be true, could have made such a reply, or how they had the audacity to act so in the face of the reports that reach us each year of the hanging of American pictures in the annual *salon*, passes comprehension. The affair is as inexplicable as is the action of Congress in declining to rescind the tariff, in spite of petitions signed by almost every artist resident abroad, and the protest of almost every reputable artist in this country — unless the solution is that the National Academy itself has the ear of Congress and is the unknown power whose arguments are more convincing than the entreaties of American artists at home and abroad. It is impossible that Congressmen should not understand how important to the progress of art in America and the advancement of our artists is the continuance of the present generous behavior of foreign governments to our art-students abroad, particularly in the case of the Ecole des Beaux-Arts at Paris. The situation is already strained, and it would not be surprising if this *contretemps* should prove the last straw.

LA REVUE INDUSTRIELLE gives a recipe for a solder to be used at a low temperature which some of our readers may find useful. In a solution of sulphate of copper in water a plate of zinc is hung, which precipitates the copper in the form of a fine black powder. The powder is collected, washed, dried, and rubbed with concentrated sulphuric acid in a porcelain or iron mortar. Seventy parts of mercury are then added, without stopping the stirring of the mixture, and the rubbing is continued until the mercury is all absorbed by the copper. The amalgam is then thoroughly washed with warm water, to remove the acid, and allowed to cool. At the end of ten or twelve hours it is hard enough to scratch tin. When wanted for use, a piece of the amalgam is heated until it softens to the consistency of wax. It is then only necessary to spread it over the surfaces to be joined, and allow it to cool. It adheres with great tenacity.

PORTUGUESE ARCHITECTURE.— I.

LISBON.



FOR some reason, Portugal seems to be but little visited by artists and even less yet by architects. It is difficult to say just why this is; for the country is quite easy of access, either by sea, if one does not object to a two or three days' voyage from England, or by rail, when one is at the same time making the circuit of Spain; and Portugal really offers many attractions to one who is interested in art of any kind, as well as to the simple tourist who travels only for the sake of new sensations and pleasant experiences. And with a climate which is a perpetual springtime all the year round, a situation hardly second to that of any city in the world, beautiful drives in every direction, good hotels and abundant opportunity for enjoyment, it is not surprising that those who do visit Lisbon are charmed with it and wonder why so few Americans ever wander in that direction. But Lisbon must be seen to be appreciated. As with a great many cities, a mere description can give very little idea of its beauties; possibly for the reason that there are not so very many things to describe, as Lisbon is poor in monuments. One can enjoy to the full the beauties of the wide Tagus, not crowded with the ships of many nations, as the guide-book announces, but simply dotted here and there with sailing and steam craft in a manner which tells of plenty of anchorage-room and a commerce not too busy for quiet enjoyment; and there are streets alive with busy trade: the Rua Aurea, lined with tempting goldsmiths' shops; an imposing square down by the water's edge, the Praca do Comercio; and there are pretty promenades and parks along the tops of some of the many steep hills about which Lisbon is built; but the architectural attractions certainly do not appear with any prominence on first acquaintance. Since 1755, the year when the city was so completely destroyed by the terrible earthquake, there have been few great architects in Portugal, and fewer yet of great buildings. A century and a half ago Lisbon must have been exceedingly rich in its architecture, however, for the few examples which the earthquake spared are by themselves of sufficient value to make a visit to the city well worth the trouble.

Down in the heart of the city, where the earthquake shocks have been most disastrous in their action, is the cathedral: a large, forlorn-looking structure externally, with two square towers on the façade, considerably the worse for Nature's rough handling, and an interior more notable for tinsel and gaudy over-decoration than for its architecture. Indeed, the cathedral as it now exists is interesting principally for its plan. In considering this building it may be of value to know that it was undoubtedly begun under English influences, as the first bishop was from Salisbury. The cathedral was built in 1147, and suffered repeatedly from earthquakes, losing nearly all of its parts except the towers and portions of the apsis, and being renewed at so many different periods that its original Gothic character has been quite obliterated by weak late Renaissance work, though the same general disposition of plan has always been preserved. Of all the churches throughout Portugal this is the one whose plan most nearly approaches the perfected Gothic type such as was understood in France. Indeed, there is no other example of any importance which possesses a fully developed circular apsis with radiating chapels.

Cathedral, Lisbon.

Lisbon extends along the right bank of the Tagus for a distance of about seven miles. The most western portion of the city is known as the suburb of Belem, and possesses some work which is worthy of careful study as being not only the best in Lisbon but also the most characteristic architectural effort the country has ever put forth. In the fifteenth century a modest and very ancient oratory existed at Belem. When Vasco de Gama was about to depart for the voyage of discovery which rendered his name so famous, he came hither to invoke the aid of the Virgin, and the Infante Don Manoël, who was to accompany him on his perilous journey, made a vow that, should the enterprise meet with the success expected, he would construct, on the site of the chapel, a church which should exceed all others in magnificence. Two years later, in accomplishment of the vow, the present church of Belem was begun. A convent was built at the same time and occupied by Hieronymite monks of the order of St. Jerome.

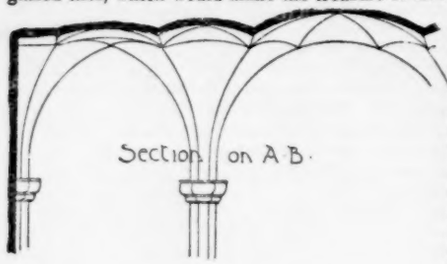
The design is wholly Portuguese in all its details, and there is no evidence, internal or external, to show that foreign influence had to do with it in any way. In this respect it is almost unique of its kind, as the greater portion of the Portuguese edifices, secular as well as religious, have been planned by foreigners, or so modified by direct foreign associations as to represent only imperfectly the true architectural tendencies of the nation. Never before or since have the Portuguese had as genuine an inspiration as is evinced here. It would be very interesting, if it were possible, to trace out the antecedents of this design, and see how it was derived from the contemporaneous architecture of other peoples; but documents are lacking altogether, and the eighteen earthquakes which have at different times visited Lisbon have quite destroyed all trace of any local edifices which could have prepared the way for a design as rich and abundant in ideas as this. The general scheme might be designated as thirteenth-century Gothic, though in no other country was the Gothic ever treated in such a florid, fantastic manner. The details of carving and ornamentation are strongly Renaissance; and in the way the finials and flowered cornices are arranged, and in the disposition of fine, fret-like ornament, contrasted with broad, plain wall-surfaces, as well as in the effective use of high lights and strong shadows — the almost plastic feeling of the design — there is evidence that the Moors left their influence in Portugal quite as strongly as in Spain. To say a design is Gothic in general scheme, Renaissance in detail, and Moorish in sentiment, might imply almost an impossibility, and yet that is exactly the impression the Belem church leaves on one's mind, though with this important modification: that Gothic, Renaissance and Moorish do not exist as such, but become as it were suggestive points of a design which is as thoroughly and consistently Portuguese as the Sainte Chapelle of Paris is French, or Giotto's Campanile Italian.

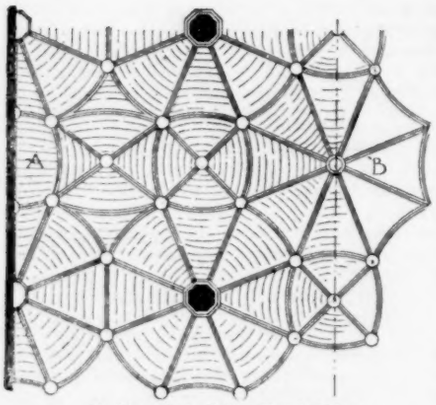
The church is built entirely of a beautiful, cream-colored sandstone, varying slightly in tone, with just enough reddish glow to give it a warm lustre; and under the vivid intensity of the southern sun the imaginative, finely-wrought design sparkles like the frost palaces of a window-pane, if one may compare the warm and the cold. The exterior is simple in the disposition of the masses, presenting a lateral façade towards the street, broken only by the slightly projected base of the unfinished western tower, and by the square and perfectly plain transept. There are no buttresses of any size, and the sky-line is formed by the serrated cresting of the cornice, the roof being so nearly flat that it does not appear with the façade, a feature common to nearly all Portuguese work. The richness is concentrated about the lateral portal shown by the sketch, a design which, while not lacking in faults, has a general effect according well with the character of the design, and possesses considerable dignity of composition, from a Portuguese standpoint, at least. Nearly all of the details of this portal are good. The statuettes, the arabesques, the heavily panelled doors, the delicate canopies, the curiously tortured shafts, the sturdy figure of the old navigator keeping watch in the centre, and the graceful statue of the Virgin rising on the topmost wave of foam-like carving, are individually so pleasing and full of spirit that one can easily pardon a great deal of the collective lack of repose.

The interior arrangement is indicated by the plan. By comparison with other Portuguese work, it would seem more than likely that the apsis was originally square in termination, with a large window behind the altar. The existing apsis is a late Renaissance alteration. The dimensions of the church are eighty-two metres from the front portal to the steps of the choir, thirty-four metres in width at the nave, and sixty-four metres across the transepts. The clear height of the nave is about thirty-five metres. The church is covered by a triple line of vaulting, of construction so daring that such a project on paper would hardly seem practicable. Indeed, as it was, the vault fell in after being first built, and history tells us that the plans of the architect inspired so little confidence that no workmen could be induced to undertake the task of rebuilding. The vault was finally completed by criminals condemned to death, who were offered a free pardon if they escaped alive. The work proved successful the second time, and held so well that, although the church was violently shaken by the great earthquake, not a stone was dislodged. It is doubtful if the French, good constructors as they were, ever built a vault which would stand so violent a test as that. The sketch diagram can give some idea of the approximate arrangement of the vault, which is not unlike the fan vaults of Henry the Seventh's chapel at Westminster, except that here the fans are not cotangent, and they make complete circuits about slender pillars, whereas in the English chapel the vault has all the benefit of the resistance of a firm, continuous wall. The supporting piers are twenty-five metres high to the spring of the vault, and about one metre and a half in diameter.

The cloisters immediately adjoin the church to the north, and are in the same style, but with details more pronouncedly Renaissance in character, which would seem to indicate that they were built later than 1500, the year the church was begun. The second-story cloisters are incomplete, lacking the slender, twisted columns, and curious, cusped archings which make the lower portion so interesting; but restorations are now in progress, and as it is simply a question of repeating details which already exist, the cloisters will eventually possess all the picturesque interest of the original design. The monastic orders were suppressed in Portugal about 1830, and the buildings of the Belem monastery were converted into a *casa pia*, or orphan

asylum, which is a model of arrangement in its way, the sanitary appliances being especially complete, a condition which somehow one seldom expects to find realized in southern countries. In the vestibule, and in the old refectory, the walls are still covered with fine old glazed tiles, which would make the treasure of some museum. They are for the most part in blue, not unlike Delft ware, and are painted with Biblical scenes. A few of the monastery buildings are not without interest. One long façade adjoining the church towards the west has been lately restored in fairly good manner, though the construction was carried on so badly that a short time since one of the new towers tumbled down to its base. The single-arched portal, shown on the sheet of sketches, is a portion of this wing of the monastery.



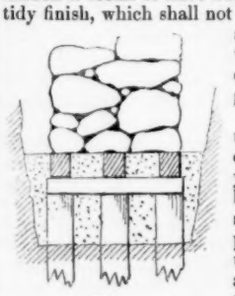


Vaulting of the Belem Church, Lisbon.

But this is not all the architectural richness which the Belem suburb possesses. About three-quarters of a mile to the west of the church, on a bit of sandy beach stretching out into the Tagus, is an interesting piece of Gothic military architecture, the purest specimen of the style in the country, and so quiet and simple by comparison with the convent church that one is strongly inclined to ascribe to it a foreign origin. It is built right out over the water, and forms nominally a part of the military defenses of Lisbon, though it is not actually used as such, and, despite its fierce embattlements and deep embrasures, it would be but a slight protection against modern artillery. Towards the land it presents a square tower, thirty metres high, flanked on the right by a heavy portcullis and gateway, and on the left by low fortifications. The elevation shown on the sheet of sketches is a measured drawing of this front. Towards the rear a wide *terrasse* extends far out over the water, guarded at the angles by heavy turrets, and with a large, open well in the centre, giving light to a spacious crypt extended under the whole platform. The tower and the adjacent parapets are crowned with high battlements, bearing shields carved with the cross of Malta. The tower is built of the same beautiful stone as was used for the monastery church, but the action of the salt air has given it more tone and deeper streaks of red, so that it forms a striking picture, whether seen from far down the river or from across the long stretch of deserted sands. The Portuguese assert it to be one of the best pieces of architecture in the country. The only drawback to such an assertion is that it is less distinctively national in character than the church, though to a stranger that might not be altogether an objection.

It is of interest to note how little influence Spain seems to have exerted upon the architectural efforts of Portugal, for, although both countries were at one time under the same government, and are separated by no great natural barriers, they are now quite distinct from each other in nearly every respect; and, excepting for the Moorish element which, after all, is very slight in its influence, Portugal seems invariably to have passed by its neighbor and drawn its ideas from countries with which it might be supposed to have far less affinity. The difference between Spain and Portugal in regard to private habitations is quite striking. In the larger country whitewash and stucco reign supreme. The ordinary Spaniard, especially if he be an Andalusian, seems to have a real mania for making everything look fresh and clean, even at the expense of covering up good architecture. The Portuguese are quite as clean in their intentions, but they secure a fresh, tidy appearance for their houses in a very different way, namely, by covering them with tiles — a custom which has been worked out nowhere else in the world. The Moors, and all the related races, used tiles very extensively for floors, dadoes, fireplaces, etc., but in Lisbon the exterior walls of nearly all the houses are covered with glazed tiles. Often there will be almost no architecture whatever; a tile base-course, tile window and door-jambs, tile belt-courses, and a tall tile frieze under the overhanging roof; but the plan usually followed is to build the walls of common, irregular, rubble stone-work, carrying up the angles of the building and all jambs in cut sandstone, and occasionally extending one or two plain belts across the front. The stone bands, both vertical and horizontal, are quite narrow, and are projected about an inch from the face of the rubble masonry. When the building is entirely completed, and has had ample time to settle, all of the rubble work is covered by tiling set in stucco or cement, so as to be flush with the cut-stone jambs and angles. This work will stand practically forever, will look as well at the end of three centuries as when first put in place, and is so far superior to stucco in every way that there is no comparison. There seems to be nothing impracticable in the application of the tiles. The writer spent several days examining this work all over the city, and did not find a single tile which was loose, or about which the pointing had worn away. The tiles are all manufactured in Lisbon, and the ordinary kind with simple, printed pattern can be had for a cent each. Generally they are figured in some way. Plain white tiles are never used, but sometimes a single tone is employed, and there is one quite striking instance, a house out towards Belem, where tiles of an unbroken, dark sulphur color are used over an entire front with a very successful effect. Blue is, however, the color most employed — a blue pattern on a white ground, the tone being pretty closely imitated in water-colors by a strong wash of French-blue. Lemon-yellow figures are sometimes used with the blue, and occasionally there is introduced some brown-madder or Hooker's-green in varying shades, though blue is always the predominating color, and is the only one which is ever used alone for a figured tile. The patterns vary infinitely. Generally nothing but geometrical designs or leaf-forms are employed; but a few of the better houses still exist which are covered with tiles painted in a more ambitious manner, with scenes wherein architectural forms and human figures are introduced, the entire façade serving as a ground for one design, which is adjusted to the architectural framework. Such examples, however, are exceedingly rare. Unglazed tiles are never used.

It is not difficult to see from whence this custom came, at least, if we may judge by external analogies. The Moors undoubtedly left in Portugal, as they did in Spain, a knowledge of the manufactures of ceramics and a taste for tile work. The Portuguese, after their brief rule over the seas, were succeeded in maritime supremacy by the Dutch, and it was from this latter people that the idea was taken, though here, again, the Portuguese showed their individuality, for, while the colors and many of the patterns are quite the same as those which are found in old Dutch tiles, the Lisbon work is a style to itself, being more free in treatment and better adapted to general effects than any Delft ware ever was. But it must be admitted that the Portuguese have by no means perfected this mode of exterior finish, or decoration, whichever it may be termed. The idea is excellent, and, properly developed, nothing more brilliant and interesting could be imagined than a long street, to say nothing of a whole city, clothed in all the beautiful hues which are to-day so easily produced by the ceramic artists. It is surely the nearest approach to a perfect scheme of exterior color-decoration that has ever been devised. In Lisbon it seems to have been worked out only enough to give a clean, tidy finish, which shall not be disagreeable to the eye nor difficult of application, and comparatively little of what can be called real design is apparent, so that the effect is not always as good as might reasonably be expected.


Piling.

A practical detail of Lisbon architecture may not be out of place here. The city is so hedged in by the hills that of late years some of the shallower portions of the broad river have been filled-in and constructions erected thereon supported by piling. The disposition of the piles is not unlike that in vogue in Amsterdam. They are driven in rows of three or more across the thickness of the wall, connected by heavy cross-timbers, and the rows united by lines of stringers or tie-beams, one over each line of piles. The spaces between the piles, and for a depth of one or two feet below the tops thereof, is filled with concrete, which is carried up to the level of the longitudinal sleepers, forming a solid platform on which is begun the work of the foundations, generally in rubble stone. The adjoining figure will illustrate this construction.

C. H. Blackall.

The Slums of Berlin. — The slums of London and Paris are bad enough, but it appears that the slums of Berlin are, if possible, worse. *Das Echo* has just published some interesting details on the subject. There are about 40,000 houses in the Prussian capital. A small number are inhabited by one or two families, but the great majority are divided into several distinct lodgings. Two thousand five hundred contain from sixteen to twenty lodgings; 20,000 from twenty to thirty lodgings, and 10,000 over thirty lodgings each. Seventy-five thousand of these lodgings are composed of one room only, and inhabited by no fewer than 270,000 persons, which is an average of nearly four persons per room; 75,000 other lodgings are composed of two rooms, and occupied by 360,000 inhabitants; while the remaining 30,000 lodgings are formed of three rooms, inhabited by 140,000 people. These figures show the promiscuous way in which the masses of Berlin population are lodged. The houses in the poor quarters, often five or six stories high, are built so close to one another that they are nearly totally devoid of light and air. — *The Building News.*

AN EDITOR'S TRIP ABROAD.[1]—VII.

THE CLEANLINESS OF GENOA.

IN my younger days I used to think a good deal about Italy. My grandfather had several pictures of Italian scenery, which seemed to indicate that the female inhabitants of the country spent their time in reclining or dancing under arbors covered with grape-vines, while the gentlemen, dressed in tight red pantaloons, made in one piece with their pointed slippers, played on guitars, and symmetrical volcanoes spouted smoke in the distance. Later, when I had German lessons to study, my previous conceptions were disturbed by reading in one of them about an Italian patriot who, when the representatives of other nations were boasting about the industries of their respective countries, could not think of any industry practised in his native land except organ-grinding; and, comparing this sort of labor with that required for keeping somewhere within sight of the head of one's class, I was led to form an unfavorable opinion of Italian energy. All this served to increase considerably my surprise at the efficiency which seemed to characterize everything in the way of official action in the small part of the real Italy that we saw. Instead of plunging at once, on crossing the frontier at Ventimiglia, into a sea of rags and beggary and filth, as we rather expected to do, we found the Italian cars and stations quite as clean as the French, and the railway and custom-house officers as prompt and civil, while the beggars, instead of following us about in swarms, were nowhere visible, and except one privileged old woman inside a church door in Genoa, I do not remember seeing a single mendicant between Ventimiglia and the Swiss frontier. As to the filth, which is, I am sure, generally supposed to be the weak point of Italy, I can only say that we found nothing of it, but were, on the contrary, filled with astonishment and admiration at the cleanliness of the city streets, particularly in Genoa, into nearly every part of which we penetrated. Paris has the reputation of being clean, but the narrower streets in Paris are foul compared with the Genoese by-ways, and to a New Yorker the proceedings of an Italian street-cleaning department must seem like a revelation. We had occasion to go through one of the busiest and dirtiest streets in Genoa, close to the docks, closely resembling, in point of situation and traffic, West Street in New York. I suppose almost every one has waded through the West Street mud, and climbed over its heaps of garbage, and most people who have been there in hot weather have probably also noted, with gratified surprise, the energy of the street-cleaning department in occasionally depositing a handful of chloride of lime on top of each of the largest garbage-heaps. In the Genoese West Street, under the government of the hand-organ grinders, there was no trace of either garbage-heaps or mud. The pavement could not, in the nature of things, be kept dry, but it was swept as clean as birch brooms could make it, and, to remove the last vestage of offence, it was dusted from side to side and from end to end with chloride of lime, put on either in fine powder or in a thin emulsion, I could not tell which. The narrower streets, all of which are paved with square stones, were continually patrolled by the uniformed sweepers of the "*pulizia delle strade*," and every cheese-paring and cabbage-stump thrown out from the houses and shops was promptly transferred to the carts which followed them, and we could walk without annoyance from one end of the city to the other, through streets varying from eight to ten feet in width, and lined with tenement-houses six or seven stories high, at a time of year when such a walk in New York would threaten one with suffocation.

We happened, by the tram-car conductor's choice rather than our own, to be landed at the door of a hotel which was, so to speak, born a palace, and had only recently been degraded to the use of tourists. I am obliged to speak with difidence of its history, being far away from my Fergusson, but we learned from the hotel waiters that the building was once one of the Brignole palaces, and I seemed to recognize in it, on studying the outside from a distance, a resemblance to one of the illustrations in Fergusson's "*History of Architecture*," representing, if I recollect rightly, what he calls the "little Brignola Palace." I think the drawing of the "little Brignola" palace shows it with a low open loggia on each side, which certainly does not exist in the hotel; but the building is now closely hemmed-in by other structures, and the loggias, which would have been suitable to the position of the palace when the Piazza Deferrari, on which it stands, was a garden, may have been removed to make way for improvements.

However that may be, the hotel-palace is still a beautiful building both inside and outside. Although small in comparison with the enormous palaces beyond it on the same street, its three stories seem to have been more easily brought into proportion than their five, and the exterior detail appeared to me the most elegant that I saw on any of the palaces, most of which are either rather bare, or overloaded with questionable ornament. Inside, the building was richer than on the outside, and much of the work was probably modern, but the general effect was excellent. Being the only strangers in the house, we were assigned rooms on the second story, which rather overwhelmed us by their air of decayed magnificence. The larger of the two rooms had once been about thirty feet wide by forty feet long, but a strip had been cut off one end by a thin partition, to form a passageway. The ceiling was coved on three sides, the cove of the fourth side being in the passageway, and the central portion seemed to rise slightly, forming a very flat dome. As nearly as I could measure it, the height from the floor to the top of the cove was twenty-two feet. The ceiling had been redecorated rather cheaply when the alterations were made, and the floor, which was originally like the floors which still remained in the halls and the other rooms in that story, of bits of marble set in cement, had been painted over to conceal its dilapidation with a dark red color, sprinkled with white from a brush. Our smaller room, which seemed to have undergone little alteration, was once apparently either an ante-room or a boudoir, attached to the large one. It was of about the same height as the other, but long and narrow, and ceiled with an elliptical vault, the whole of which, together with the walls down to the height of the wainscot, was covered with plaster decoration in relief. The style of the work was perhaps a trifle exuberant, but the effect of the wreaths of flowers and the cherubs nearly half-life size, which sprawled over the walls, was, to our unaccustomed eyes, very rich and gay. What the original coloring may have been I cannot say, the whole being now painted white, with a little tinting here and there, but from the circumstance that two frames were formed in the centre of the principal wall-surfaces, in which were still set what purported to be family portraits, I suppose that much of the work must have been originally gilded. In the large reading-room on the first story, which was also long and narrow, and had an elliptical ceiling decorated in the same way, the reliefs were nearly all gilded, while the panels were filled with extremely pretty and rich flower and figure painting. The walls of the reading-room, however, instead of rococo panelling were divided by coupled pilasters between which were set mirrors occupying all the space not taken up with windows or doors. The Roman mosaic, as we call it, of broken pieces of colored marble, up to an inch square, set in hard gray or red cement, and rubbed down with a flat stone and sand to a level surface, covered all the principal floors, as well as the stair-landings in the building, the stairs themselves being of white marble. It is usual with us to leave such pavements, after they are once laid, to their own sense of propriety as to keeping themselves clean, sometimes, perhaps, washing them with water or milk, but we discovered that those at Genoa, which had a remarkable polish, were waxed and rubbed regularly, just like an oak floor.

The situation of the hotel gave us an excellent opportunity for observing one of the most amusing of Genoese sights, the morning market. Under the city regulations certain public squares are allowed to be occupied every morning until nine o'clock by the retail venders of vegetables, fruit, eggs and such things, who, in other towns are accommodated in the great market-halls. The Piazza Deferrari is one of the public places so used, and soon after daylight the dealers, most of whom were women, began to arrive, carrying baskets of oranges, cherries, apricots, cabbages, potatoes, eggs, mushrooms, live snails, and other delicacies, together with coarse cloths which they spread on the pavement and utilized for displaying their merchandise. There was food for the mind as well as the body, at least half-a-dozen baskets of second-hand books always contending for space with the turnips and onions, while heaps of bandana handkerchiefs, coarse lace, fans, calicoes, soap and cheap fancy goods, gave variety to the exhibition. By seven or eight o'clock nearly every foot of the pavement was covered either with the market-people and their goods, or with their customers, who moved about sometimes with their own baskets on their arms, and sometimes with servants following them to carry their purchases. Simple as the affair was, the color and movement of the crowd made the scene a very picturesque one, and one spectator, at least, was extremely sorry when the clock struck nine, and, as the last stroke of the bell died away, the delegates of the Street Polishing Department made their appearance in the square. Beginning at the side next the street, they advanced, swinging their brooms, and the market melted away before them. The potato-men and the orange-women, the book-sellers and snail-dealers, hastily gathered up their goods and retreated homeward, and in ten minutes not a cabbage-leaf or peach-stone was left in the square to tell of the busy scene which had occupied it all the morning. To me there was something wonderful in this vigorous cleanliness, The Genoa of my mind had always been an unsavory place, ragged. tawdry and pretentious. Instead of that, I found the real town neat and orderly beyond anything that I had ever seen, filled, not with shabby old palaces, but with houses which, at the worst, always made a tolerably successful effort to look dignified, and showing indications in every direction of prosperity and happiness. Of my old friend with the red pantaloons and the guitar there was no trace, but in place of him were troops of bright-looking children, who apparently spend their time, not in lounging about grape arbors, but in good,

[1] Continued from page 48, No. 553.

hard work in the numberless schools which, ranging from the kindergarten to the "Marine and Technical Institutions" for boys, were to be seen on all sides; and, although there was less sentiment about their little uniforms than in his rolling eyes, I could not say that I regretted his absence, or that the Genoese had less reason now to be proud of their city than in the days when they put up the arms of Genoa, where they still remain over the chancel-arch of their great cathedral, in the place where other people put the cross. In fact, Northwestern Italy generally seems to be full of enterprise and prosperity. From Ventimiglia to Milan, and in the vacant spaces around both cities, we saw new houses, manufactories, wharves and engineering works everywhere. North of Milan, on the shore of Lake Maggiore, a new railroad connecting this with Lake Como, was on the point of being opened to the public, and we saw constantly from the diligence, in going from Pellanza to the Simplon, the splendidly finished constructions of the great road which is about to pierce the mountains with the fourth Alpine tunnel, to connect the railway system of Eastern France with that of Italy.

TABLE OF ILLUSTRATIONS

Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]

CHICKERING HALL, FIFTH AVENUE, NEW YORK, N. Y. MR. GEORGE B. POST, ARCHITECT, NEW YORK, N. Y.

[Gelatine Print, issued only with the Imperial Edition.]

SKETCHES OF PORTUGUESE ARCHITECTURE.—I. BY MR. C. H. BLACKALL, ARCHITECT.

For description see article elsewhere in this issue.

OLD COLONIAL WORK, NOS. XI AND XII. DETAILS FROM TRINITY CHURCH, NEWPORT, R. I. MEASURED AND DRAWN BY MESSRS. F. E. WALLIS AND E. G. HARTWELL.

COMPETITIVE DESIGNS FOR A $5,000-HOUSE, SUBMITTED BY "*Novel*" AND "*W.*"

For the jury's comments, see elsewhere in this issue.

AMERICAN ARCHITECT COMPETITION FOR HOUSE COSTING $5,000.[1]—IV.

"*IX.*"—Novelist not isolated. Waste room in hall. Kitchen in basement requires extra servant. Details are not good, but general mass of house is excellent, simple, direct, and well proportioned. Porch perhaps a little light. Rendering is unskilful.

"*W.*"—Plan compact and good. No especial provision for use of bedrooms as nurseries. Design of exterior wants study in proportions, is somewhat bald and somewhat too high in second story. Details are good and rendering is good.

"*A Starter.*"—Novelist is not isolated. Plan fairly good otherwise. No constructive details. Interior designs crude and coarse. Exterior much better. The design could, by slight simplifications, such as leaving out the plaster and mock-timber work in gables, giving up an exterior chimney, be made into a good and satisfactory house. Rendering is not good, has a crude, rough look, principally caused by too black shadows badly cross-hatched.

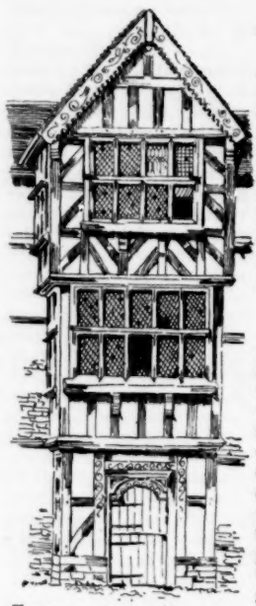
Novel.—A basement kitchen is objectionable for reasons already stated. The study is over the kitchen and would be uncomfortable from both smell and noise. Details are overdone, especially in gables. Stair balusters have very poor turnings. The concave forms used in staircase and in dormer windows are always bad. Exterior lacks quiet, is spotty. Roof too small for walls and whole house is too much cut up. Rendering of plans good, lettering poor. Rendering of perspective clear but spotty. No light and shade.

[To be continued.]

[1] Continued from page 50, No. 553.

SAFE BUILDING.[2]—VI.

RULES FOR CALCULATING TRANSVERSE STRAINS.



FROM AN OLD HOUSE.
AFTER SKETCH BY E.J.MAY
AA SKETCH BOOK. LONDON. LUDLOW, ENG.

Summary of Rules.

1. *Find Reaction of each Support.*

If the loads on a girder are uniformly or symmetrically distributed, each support carries or reacts with a force equal to one-half of the total load. If the weights are unevenly distributed, each support carries, or the reaction of each support is equal to, the *sum* of the products of *each* load into its distance from the *other* support, divided by the whole length of span. See Formulæ (14), (15), (16), and (17).

2. *Find Point of Greatest Bending Moment.*

The greatest bending moment of a uniformly or symmetrically distributed load is always at the centre. To find the *point* of greatest bending moment, when the loads are unevenly distributed, begin at either support and pass over load after load until an amount of loads has been passed *equal* to the amount of reaction at the support from which the start was made, and this is the desired point. In a cantilever the point of greatest bending moment is always at the wall.

3. *Find the Amount of the Greatest Bending Moment.*

In a beam (supported at both ends) the greatest bending moment is at the centre of the beam, provided the load is uniform, and this moment is equal to the product of the whole load into one-eighth of the length of span, or

$$m = \frac{u.l}{8} \qquad (21)$$

Where m = the greatest bending moment (at centre), in lbs. inch, of a uniformly-loaded beam supported at both ends.

Where u = the total amount of uniform load in pounds.

Where l = the length of span in inches.

If the above beam carried a central load, in place of a uniform load, the greatest bending moment would still be at the centre, but would be equal to the product of the load into one-quarter of the length of span, or

$$m = \frac{w.l}{4} \qquad (22)$$

Where m = the greatest bending moment (at centre), in lbs. inch, of a beam with concentrated load at centre, and supported at both ends.

Where w = the amount of load in pounds.

Where l = the length of span in inches.

To find the greatest bending moment of a beam, supported at both ends, with loads unevenly distributed, imagine the girder cut at the point (previously found) where the greatest bending moment is known to exist; then the *amount* of the bending moment at that point will be equal to the product of the reaction (of either support) into its distance from said point, less the *sum* of the products of *all* the loads on the *same* side into their respective distances from said point, *i. e.*, the point where the beam is supposed to be cut. To check the whole calculation, try the reaction and loads of the discarded side of the beam, and the same result should be obtained.

To put the above in a formula, we should have:—

Amount of greatest bending moment.

$$m_A = p.x - \Sigma(w_{\text{I}}\, x_{\text{I}} + w_{\text{II}}\, x_{\text{II}} + w_{\text{III}}\, x_{\text{III}}, \text{ etc.}) \qquad (23)$$

And as a *check* to above:

$$m_A = q.(l-x) - \Sigma(w_{\text{IIII}}\, x_{\text{IIII}} + w_{\text{V}}\, x_{\text{V}} + w_{\text{VI}}\, x_{\text{VI}}) \text{ etc.} \qquad (24)$$

Where A = is the point of greatest bending moment.

[2] Continued from page 9, No. 549.

GLOSSARY OF SYMBOLS.—The following letters, in *all cases*, will be found to express the same meaning, *unless distinctly otherwise stated*, viz.:—

a = *area*, in square inches.
b = *breadth*, in inches.
c = constant for *ultimate resistance to compression*, in pounds, per square inch.
d = *depth*, in inches.
e = constant for *modulus of elasticity*, in pounds-inch, that is, pounds per square inch.
f = *factor-of-safety*.
g = constant for *ultimate resistance to shearing*, per square inch, across the grain.
g_1 = constant for *ultimate resistance to shearing*, per square inch, lengthwise of the grain.
h = *height*, in inches.
i = *moment of inertia*, in inches. [See Table I.]
k = *ultimate modulus of rupture*, in pounds, per square inch.
l = *length*, in inches.
m = *moment or bending moment*, in pounds-inch.
n = *constant* in Rankine's formula for compression of long pillars. [See Table I.]
o = the *centre*.
p = the *amount* of the *left-hand re-action* (or support) of beams, in pounds.
q = the *amount* of the *right-hand re-action* (or support) of beams, in pounds.
r = *moment of resistance*, in inches. [See Table I.]
s = *strain*, in pounds.
t = constant for *ultimate resistance to tension*, in pounds, per square inch.
u = *uniform load*, in pounds.
v = *stress*, in pounds.
w = *load at centre*, in pounds.
x, y and z signify *unknown quantities*, either in pounds or inches.
δ = *total deflection*, in inches.
ρ^2 = *square of the radius of gyration*, in inches. [See Table I.]
$\mathfrak{D}$ = *diameter*, in inches.
$\mathfrak{r}$ = *radius*, in inches.
π = 3.14159, or, say, 3.1-7 signifies the *ratio of the circumference and diameter of a circle.*

If there are more than one of each kind, the second, third, etc., are indicated with the Roman numerals, as, for instance, a, a_{II}, a_{III}, a_{IIII}, etc., or b, b_{II}, b_{III}, b_{IIII}, etc.

In taking moments, or bending moments, strains, stresses, etc., to signify at what point they are taken, the letter signifying that point is added, as, for instance:—

m = moment or bending moment at *centre*.
m_A = " " " *point A.*
m_B = " " " *point B.*
m_X = " " " *point X.*
s = strain at *centre*.
s_B = " *point B.*
s_X = " *point X.*
v = stress at *centre*.
v_D = " *point D.*
v_X = " *point X.*
w = load at *centre*.
w_A = " *point A.*

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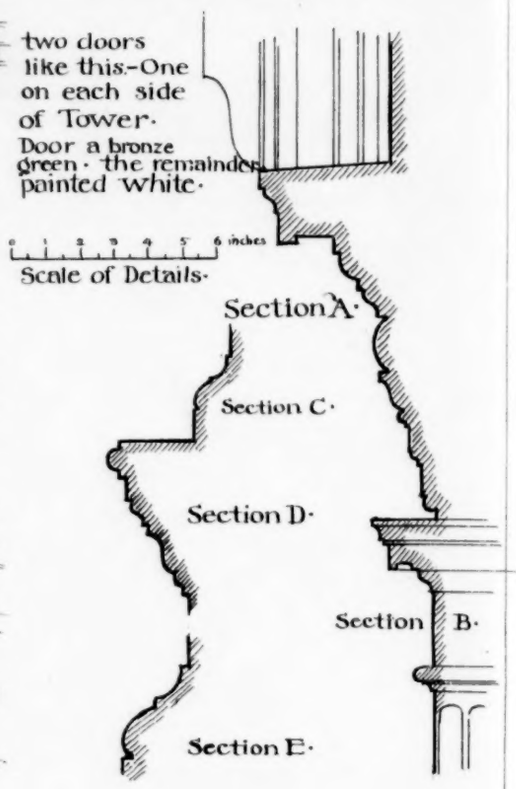
TRINITY CHURCH III

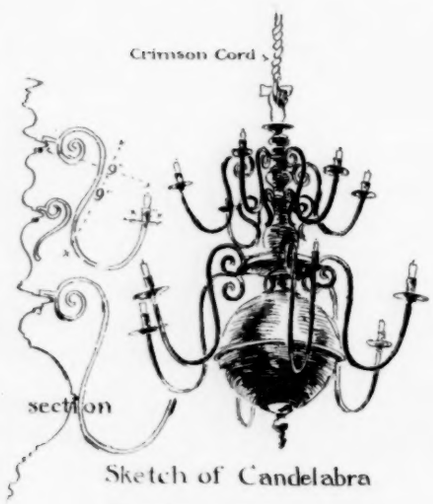
NEWPORT R.I.

Measured and drawn by F.E.Wallis.

A Sketch of Tower Entrance

two doors like this.-One on each side of Tower.
Door a bronze green. the remainder painted white.

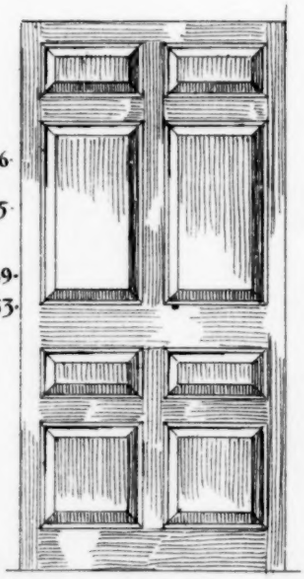




Sketch of Candelabra
Of Polished Brass.

Church Built A.D.1726.
One Bay added to length A.D.1765.
Bell given by Queen Anne A.D.1709.
Recast A.D.1733.

Sketch of Spire.



North Door of Church.

Heliotype Printing Co Boston.

OLD COLONIAL WORK, XI.

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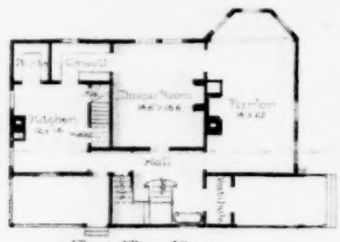
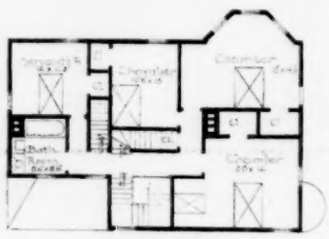
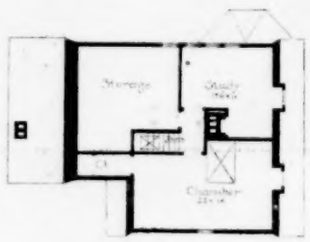


First Floor Plan

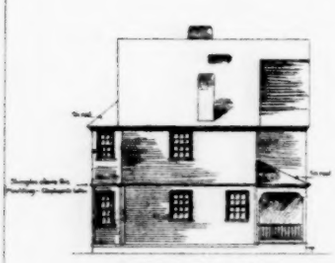


Second Floor Plan



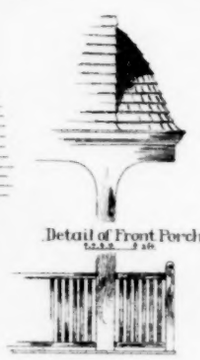
Attic Plan

A $5000 House
American Architect Competition
Submitted by "W"



Rear Elevation

Entrance Door



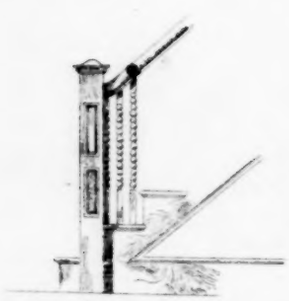
Detail of Front Porch

Rake Moulding

Water Table

Window Jamb

View in Hall



Detail of Stairs

Elevation of Dormer

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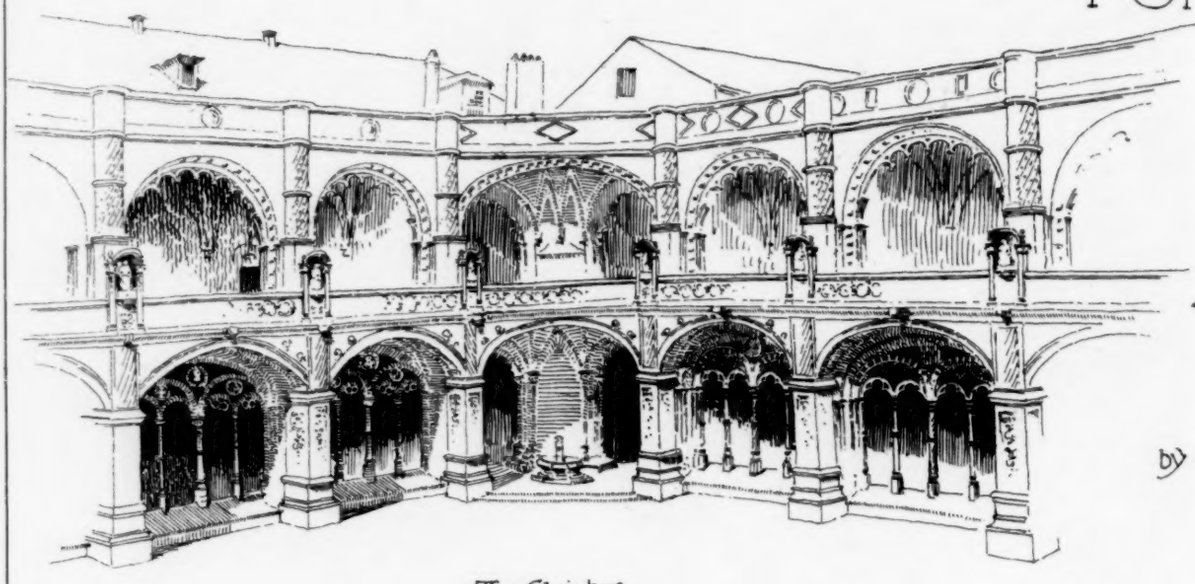
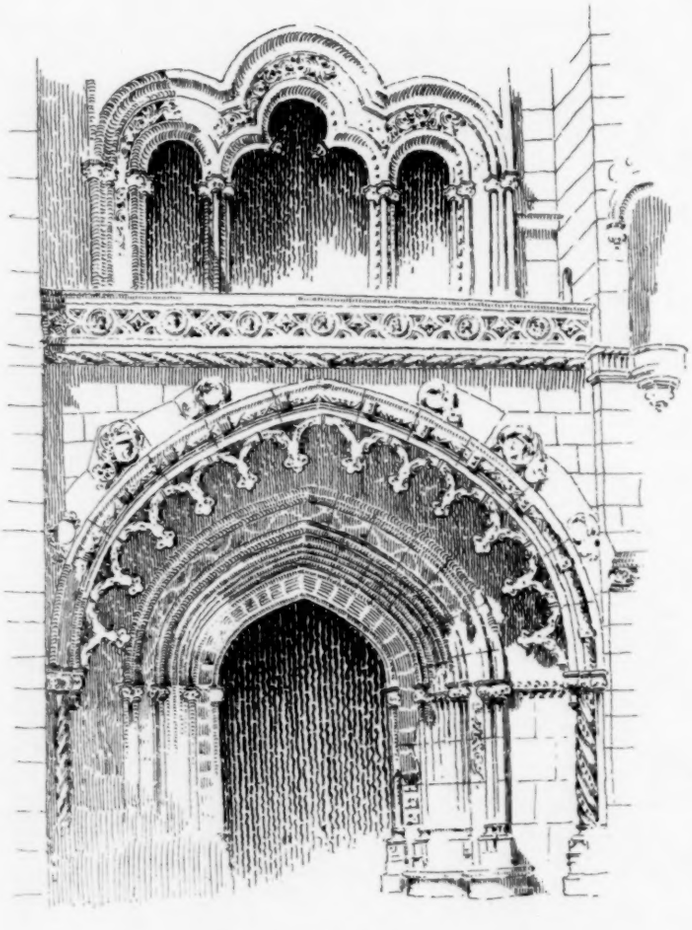
PORTUG A

Sketches

by C. H. Blacka



The Cloisters.



A detail of the Monastery.

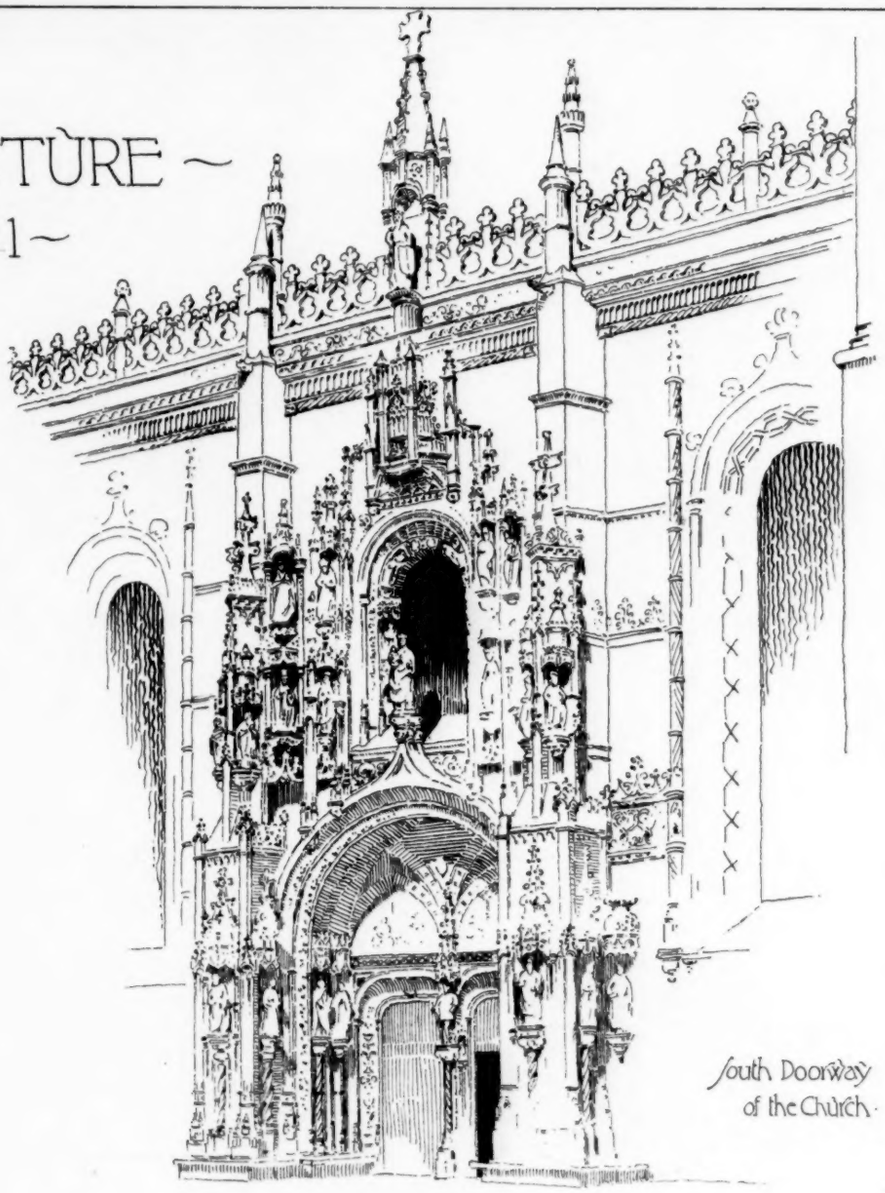
The Tower.

RTUGUESE ARCHITECTURE ~

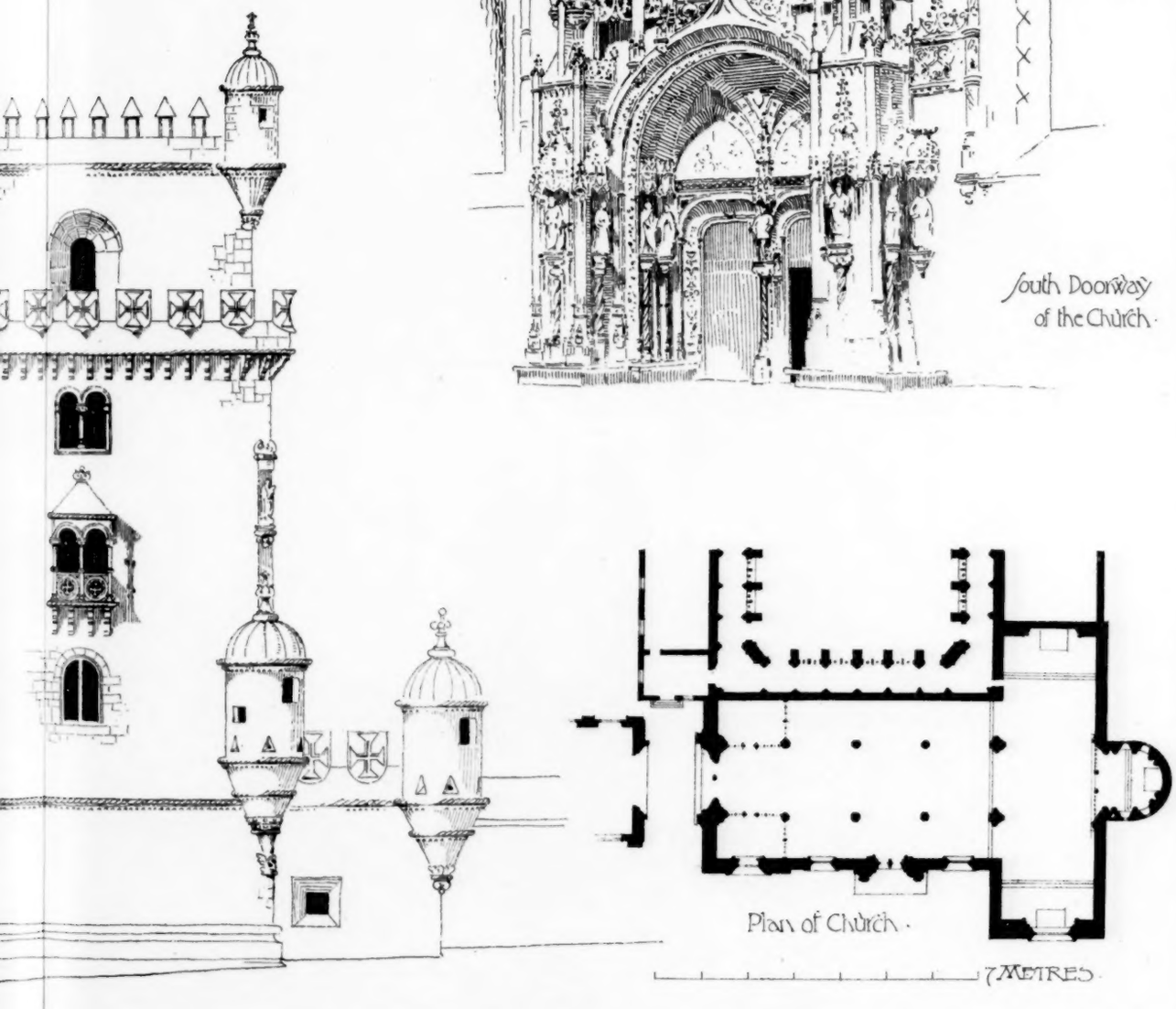
~ No. 1 ~

Sketches from Belem ~ Lisbon.

C. H. Blackall.



South Doorway of the Church.



Plan of Church.

7 METRES.

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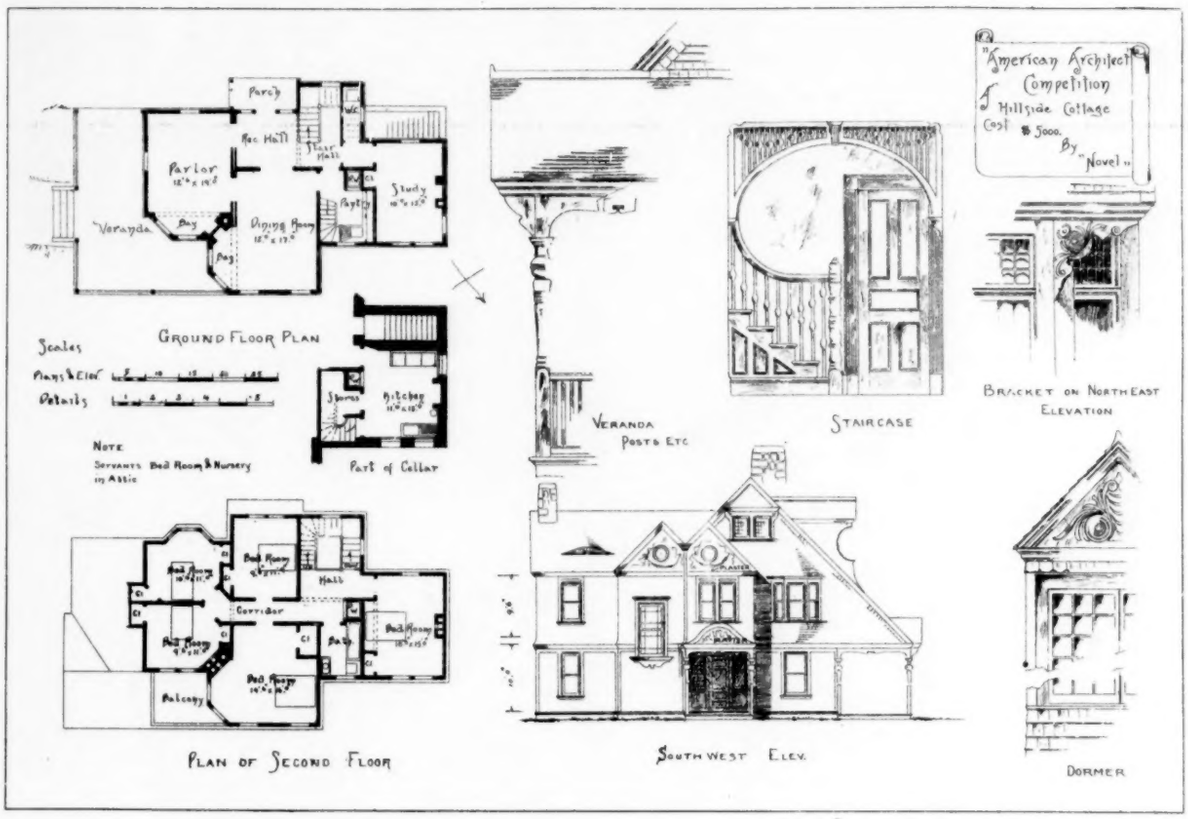

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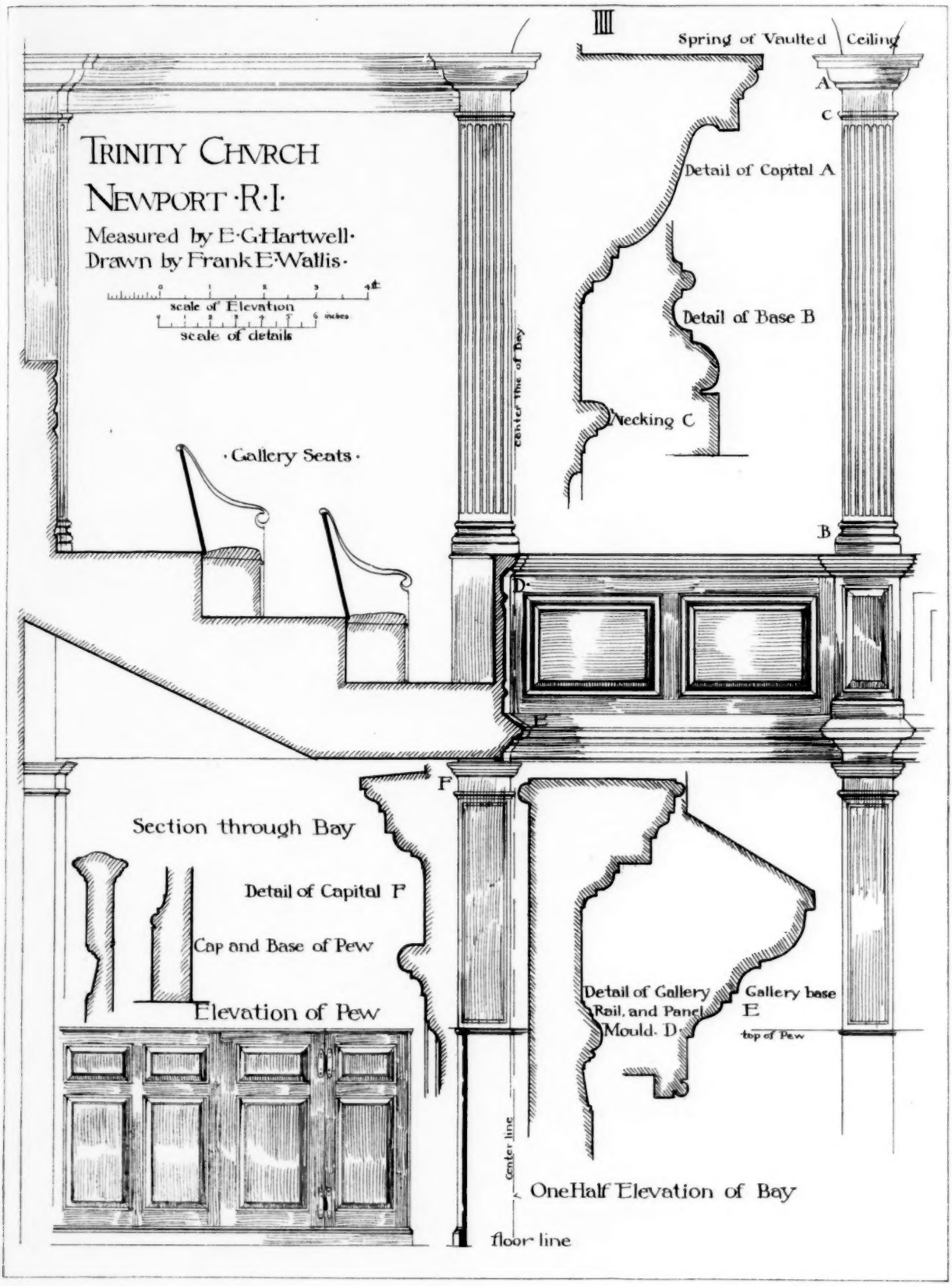

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OLD COLONIAL WORK, XII.

Where m_A = is the amount of bending moment, in lbs. inches, at A.
Where p = is the left-hand reaction, in pounds.

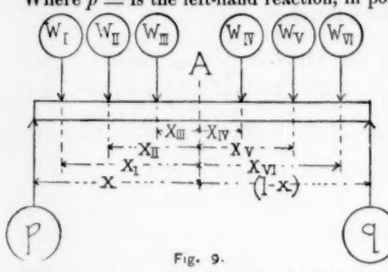


Fig. 9.

Where q = is the right-hand reaction, in pounds.
Where x and $(l-x)$ = the respective distances in inches, of the left and right reactions from A.
Where x_I, x_{II}, x_{III}, etc., = the respective distances, in inches, from A, of the loads w_I, w_{II}, w_{III}, etc.
Where w_I, w_{II}, w_{III}, etc., = the loads, in pounds.
Where Σ = the sign of summation.

The same formulæ, of course, would hold good for any point of beam.

In a cantilever (supported and built in at one end only), the greatest bending moment is *always* at the point of support.

For a uniform load, it is equal to the product of the whole load into one-half of the length of the free end of cantilever, or

$$m = \frac{u.l}{2} \qquad (25)$$

Where m = the amount, in lbs. inch, of the greatest bending moment (at point of support).
Where u = the amount of the whole uniform load, in pounds.
Where l = the length, in inches, of the free end of cantilever.

For a load concentrated at the free end of a cantilever, the greatest bending moment is at the point of support, and is equal to the product of the load into the length of the free end of cantilever, or

$$m = w.\,l \qquad (26)$$

Where m = the amount, in lbs. inch, of the greatest bending moment (at point of support).
Where w = the load, in pounds, concentrated at free end.
Where l = the length, in inches, of free end of cantilever.

For a load concentrated at any point of a cantilever, the greatest bending moment is at the point of support, and is equal to the product of the load into its distance from the point of support, or

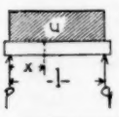
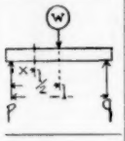
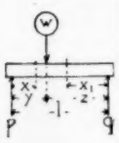
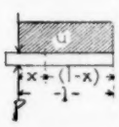
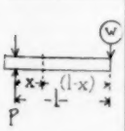
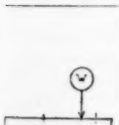
$$m = w.\,x \qquad (27)$$

Where m = the amount, in lbs. inch, of the greatest bending moment (at point of support).
Where w = the load, in pounds, at any point.
Where x = the distance, in inches, from load to point of support of cantilever.

Note, that in all cases, when measuring the distance of a load, we must take the shortest distance (at right angles) of the vertical

TABLE VII.

BENDING-MOMENT (m) AND AMOUNT OF SHEARING-STRAIN (s) OF BEAMS AND CANTILEVERS FOR VARIOUS LOADS.[1]

Manner of Loading.	Description.	m and s at centre.	m and s at any point distant x from support p.	Location and amount of greatest bending-moment m.	Location and amount of greatest shearing-strain s.	Location and amount of greatest deflection δ.
	Uniform load on beam supported at both ends.	$m = \frac{u.l}{8}$ $s = o$	When x greater than $\frac{l}{2}$ use $(l-x)$ in place of x. $m = \frac{u}{2}.x.\left(1-\frac{x}{l}\right)$ $s = u.\left(\frac{1}{2}-\frac{x}{l}\right)$	at centre $m = \frac{u.l}{8}$	at support p or q. $s = \frac{u}{2}$	at centre $\delta = \frac{5}{384}\cdot\frac{u.l^3}{e.i}$
	Load at centre of beam supported at both ends.	$m = \frac{w.l}{4}$ $s = o$	When x greater than $\frac{l}{2}$ use $(l-x)$ in place of x. $m = \frac{w}{2}.x$ $s = \frac{w}{2}$	at centre $m = \frac{w.l}{4}$	at support p or q $s = \frac{w}{2}$	at centre $\delta = \frac{1}{48}\cdot\frac{w.l^3}{e.i}$
	Load at any point on beam supported at both ends.	If y greater than $\frac{l}{2}$: $m = \frac{w.z}{2}$ $s = \frac{w.z}{l}$ If y smaller than $\frac{l}{2}$: $m = \frac{w.y}{2}$ $s = \frac{w.y}{l}$	At load use: $m = \frac{w.y.z}{l}$ $s = o$ For x use: $m = \frac{w.z.x}{l}$ $s = \frac{w.z}{l}$ For x_1 use: $m = \frac{w.y.x_1}{l}$ $s = \frac{w.y}{l}$	at load $m = \frac{w.y.z}{l}$	at nearer support p If y smaller than $\frac{l}{2}$ $s = \frac{w.z}{l}$ at support q. If y greater than $\frac{l}{2}$ $s = \frac{w.y}{l}$	at load $\delta = \frac{w.y.z}{9.l.e.i}\sqrt{\frac{y.(l+z)^3}{3}}$
	Uniform load on cantilever.	$m = \frac{u.l}{8}$ $s = \frac{u}{2}$	At free end use: $m = o$ $s = o$ For x use: $m = \frac{u.(l-x)^2}{2.l}$ $s = \frac{u.(l-x)}{l}$	at support p $m = \frac{ul}{2}$	at support p $s = u$	at free end $\delta = \frac{1}{8}\cdot\frac{u.l^3}{e.i}$
	Load at free end of cantilever.	$m = \frac{w.l}{2}$ $s = w$	At free end use: $m = o$ $s = o$ For x use: $m = w.(l-x)$ $s = w$	at support p $m = w.l$	at support p $s = w$	at free end $\delta = \frac{1}{3}\cdot\frac{w.l^3}{e.i}$
	Load at any point of Cantilever.	If y greater than $\frac{l}{2}$: $m = w.\left(y-\frac{l}{2}\right)$ $s = w$ If y smaller than $\frac{l}{2}$: $m = o$ $s = o$	If $x = y$ use: $w = o$ $s = o$ If x greater than y use: $m = o$ $s = o$ If x smaller than y use: $m = w.(y-x)$ $s = w$	at support p $m = w.y$	at support p $s = w$	at load $\delta = \frac{1}{3}\cdot\frac{w.y^3}{e.i}$

(1) If a beam supported at both ends and loaded uniformly will safely carry an amount of load = u; then will the same beam:

(2) if both ends are built in solidly and load uniformly distributed, carry $1\frac{1}{2}.\,u$,

(3) if one end is supported and other built in solidly and load uniformly distributed, carry $1.\,u$,

(4) if both ends are built in solidly and load applied in centre, carry $1.\,u$,

(5) if one end is supported and other built in solidly and load applied in centre, carry $\frac{3}{8}.\,u$,

(6) if both ends are supported and load applied in centre, carry $\frac{1}{2}.\,u$,

(7) if one end is built in solidly and other end free (cantilever) and load uniformly distributed, carry $\frac{1}{4}.\,u$,

(8) if one end is built in solidly and other end free (cantilever) and load applied at free end, carry $\frac{1}{8}.\,u$.

That is, in cases (1), (3) and (4) the effect would be the same with the same amount of load; in case (2) the beam could safely carry $1\frac{1}{2}$ times as much load as in case (1); in case (5) the beam could safely carry only $\frac{3}{8}$ as much as in case (1), etc., *provided that the length of span is the same in each case.*[2]

If the amount of deflection in case (1) were δ_1 then would the amount of deflection in the other cases be as follows:

Case (2) $\delta_{II} = \frac{1}{2}.\,\delta_1$
Case (3) $\delta_{III} = \frac{2}{5}.\,\delta_1$
Case (4) $\delta_{IV} = \frac{2}{5}.\,\delta_1$
Case (5) $\delta_V = \frac{3}{4}.\,\delta_1$
Case (6) $\delta_{VI} = 1\frac{2}{3}.\,\delta_1$
Case (7) $\delta_{VII} = 9\frac{3}{5}.\,\delta_1$
Case (8) $\delta_{VIII} = 25\frac{3}{5}.\,\delta_1$

[1] All measurements in inches; all weights in pounds; e = modulus of elasticity in pounds inch; i = moment of inertia of cross-section of beam or cantilever around its neutral axis in inches; m = bending-moment in pounds inch; s = amount of shearing strain in pounds; δ = total amount of deflection in inches.

[2] To count on the end of a beam being built in solidly would be very bad practice in most cases of building construction; as, for instance, a wooden beam with end built in solidly could not fall out in case of fire, and would be apt to throw the wall. Even where practicable, it would require very careful supervision to get the beam built in properly; then, too, it causes upward strains which must be overcome, complicating the calculations unnecessarily. In most cases where it is necessary to "build in" beam ends, the additional strength and diminished deflection thereby secured had better be credited as an additional margin of safety. The above rules for deflection do not hold good if the beam is not of uniform cross-section throughout; the deflection being greater as the variation in cross-section is greater.

neutral axis of the load, (that is, of a vertical line through the centre of gravity of the load.)

4. *Find the Required Cross-section.*

To do this it is necessary first to find what will be the required moment of resistance.

If the cross-section of the beam is *uniform* above and below the neutral axis, we use Formula (18), viz.:—

$$r = \frac{m}{\left(\frac{k}{f}\right)}$$

If the cross-section is *unsymmetrical*, that is, not uniform above and below the neutral axis, we use for the *fibres above the neutral axis*, formula (19), viz.:—

$$r = \frac{m}{\left(\frac{c}{f}\right)}$$

and for the *fibres below the neutral axis*, Formula (20), viz.:—

$$r = \frac{m}{\left(\frac{t}{f}\right)}$$

In the latter two cases, for economy, the cross-section should be so designed that the respective distances of the upper and lower edges (extreme fibres), from the neutral axis, should be proportioned to their respective stresses or capacities to resist compression and tension. This will be more fully explained under cast-iron lintels.

A simple example will more fully explain all of the above rules.

Example.

Three weights of respectively 500 *lbs.*, 1000 *lbs., and* 1500 *lbs., are placed on a beam of* 17′ 6″ *(or* 210″*) clear span,* 2′ 6″ *(or* 30″*),* 7′ 6″ *(or* 90″*), and* 10′ 0″ *(or* 120″*) from the left-hand support. The modulus of rupture of the material is* 2800 *lbs. per square inch. The factor-of-safety to be used is* 4. *The beam to be of uniform cross-section. What size of beam should be used?*

1. *Find Reactions (see formulæ* 16 *and* 17*).*

Reaction p will be in pounds, $= \frac{500.180}{210} + \frac{1000.120}{210} + \frac{1500.90}{210} =$ $1642\frac{6}{7}$ pounds.

Reaction q will be in pounds, $= \frac{500.30}{210} + \frac{1000.90}{210} + \frac{1500.120}{210} =$ $1357\frac{1}{7}$ pounds.

Check, $p + q$ must equal whole load, and we have in effect:—

$p + q = 1642\frac{6}{7} + 1357\frac{1}{7} = 3000$, which

being equal to the sum of the loads is correct, for:—

$500 + 1000 + 1500 = 3000$.

2. *Find Point of Greatest Bending Moment.*

Begin at p, pass over load 500, plus load 1000, and we still need to pass $142\frac{6}{7}$ pounds of load to make up amount of reaction p ($1642\frac{6}{7}$ lbs.); therefore, the greatest bending moment must be at load 1500; *check*, begin at q and we arrive only at the first load (1500) before passing amount of reaction q ($1357\frac{1}{7}$ lbs.), therefore, at load 1500 is the point sought.

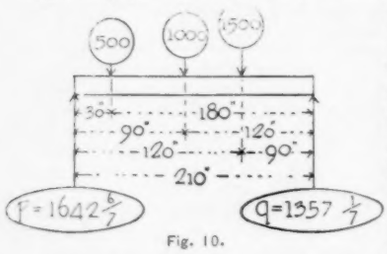


Fig. 10.

3. *Find Amount of Greatest Bending Moment.*

Suppose the beam cut at load 1500, then take the left-hand side of beam, and we have for the bending moment at the point where the beam is cut.

$$\begin{aligned} m &= 1642\tfrac{6}{7}.120 - (500.90 + 1000.30 + 1500.0) \\ &= 197143 - (45000 + 30000 + 0) \\ &= 197143 - 75000 \\ &= 122143 \text{ lbs. inch.} \end{aligned}$$

As a check on the calculation, take the right-hand side of beam and we should have:—

$$\begin{aligned} m &= 1357\tfrac{1}{7}.90 - 1500.0 \\ &= 122143 - 0 \\ &= 122143 \text{ lbs. inch,} \end{aligned}$$

which, of course, proves the correctness of former calculation.

4. *Find the Required Cross-section of Beam.*

We must first find the required moment of resistance, and as the cross-section is to be uniform, we use formula (18), viz.:—

$$r = \frac{m}{\left(\frac{k}{f}\right)}$$

Now, $m = 122143$, and $\frac{k}{f} = \frac{2800}{4} = 700$, therefore,

$$r = \frac{122143}{700} = 174{,}49 \text{ or say } = 174{,}5$$

Consulting Table I, fourth column, for section No. 2, we find

$r = \frac{bd^2}{6}$, we have, therefore,

$\frac{bd^2}{6} = 174{,}5$ or $bd^2 = 1047$.

If the size of either b or d is fixed by local conditions, we can, of course, find the other size (d or b) very simply; for instance, if for certain reasons of design we did not want the beam to be more than 4″ wide, we should have

$b = 4$, therefore, $4.d^2 = 1047$, and

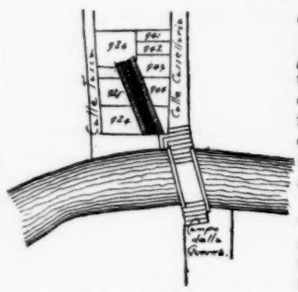
$d^2 = \frac{1047}{4} = 262$, therefore, $d =$ (about) 16″,

or, if we did not want the beam to be over 12″ deep, we should have

$d = 12$, and $d^2 = 12.12 = 144$, therefore,

$b.144 = 1047$, and $b = \frac{1047}{144} = 7{,}2$″ or say $7\frac{1}{4}$″.

AN ANCIENT VENETIAN SEWER AND MODERN DRAINAGE.



AT the beginning of the present year, in laying the foundations of a new house at S. Lio, near the Ponte della Guerra, a sewer was discovered, which from its size, its form, the materials of which it is composed, and the depth at which it was found, must be considered an ancient one.

The extrados of the barrel-vault which covers the sewer was found at a depth of 0.21 metres below the high-water level. The top of the new piling only reached the springing of the said vault, but in certain parts, it having been necessary to excavate the ground, the level of the bottom was reached at 2.51 metres below the high-water level.

The internal dimensions of the sewer are 1.95 metres in width and 2.15 in height. The bottom is formed of boards of oak and pine, four or five centimetres thick, and laid crosswise; on the ends of these are set the side walls, diminishing on the outside, and made of sandstone in roughly quarried blocks. The vault, formed of small bricks, $0.155 \times 0.08 \times 0.048$ metres each, is 35 centimetres thick for about half its curve, and it is reduced to one brick in thickness at the top.

The mortar, of white Istrian lime, *broada*, that is slaked at the moment of use, is identical with that of our most ancient buildings, and the same may be said for the sandstone and the oak. As for the pine, one of our wild kinds (*sylvestris* or *maritima*), it is not surprising to find it in an ancient Venetian construction, when we remember what a great extension the pine-woods (*pinete*) had on our shores. The sewer at S. Lio was completely filled up by a black deposit, which when cut by the shovel seemed like pitch,[1] a proof of long use and of a still longer period passed since it was abandoned, for when its communication with the canal was cut off it became full, yet the pine boards of its bottom were not rotted nor impregnated, so that on splitting one of them the interior of the wood was found of a bright reddish-yellow color, and seemed to preserve the resin as when it was first cut.

The bricks are the so-called *altinelle*, which were brought by the Venetians from the ruins of Altino, when they took refuge on the islands of the lagoon, and in our buildings of the Byzantine time we find continually these small bricks, to which the mortar of Istrian lime has never adhered, and which are found already crushed or are easily broken, showing a mixture of dirty and ill-baked clay.

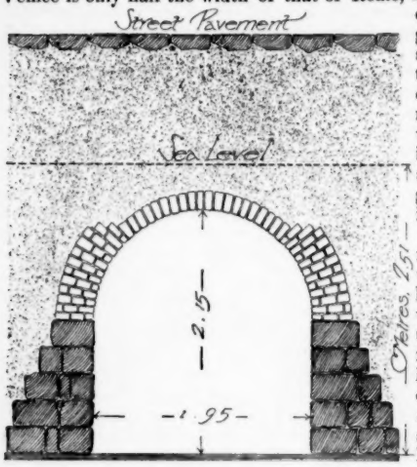
If the materials of this sewer correspond with those of the most ancient Venetian buildings that have come down to us, we have another and curious indication of antiquity in the fact that the sewer forms an angle of about 30° with the line of the adjoining street, and therefore penetrates in an oblique direction under the foundations of the houses, or rather has been broken and divided when the said foundations were constructed, a proof that it existed previously to those buildings or to their present arrangement. Beyond the first houses the sewer turns in the direction of the street, and the island of S. Lio, bounded by the Canal della Guerra and by that of S. M. Formosa, was by it divided nearly in the centre.

It is worth while noticing the special care taken in the construction of this sewer, and if its result was diminished by an execution which left something to be desired, this happened rather through the inexperience than the carelessness of the builders. The wood bottom passing under the side walls bound them together. These walls, with external footings, present the best conditions of stability, and do not take up the space in the drain. The barrel-vault springs with a thickness corresponding to that of the walls, and keeps this for a space sufficient to avoid the danger of breaking by lateral thrust, and is then reduced in thickness, in order also to facilitate a periodical demolition in some parts.

When we compare this ancient sewer with the modern street-drains,

[1] Some curious objects have been found imbedded in it, among them several spoons of gilt metal and one of ashwood, with a Gothic mark on its handle.

we notice the greater size of the early one, a fact not new in the history of construction. The Romans of the time of the Kings built the Cloaca Maxima, *receptaculum omnia purgamentorum Urbis*, a construction to which, according to Livy (I, lvi, 2), the later constructions could scarcely be compared. This primitive sewer of Venice is only half the width of that of Rome, but in a city formed of islands joined together, the public sewers, limited in their length by the canals, could not reach the dimensions which are characteristic of the Roman sewer and of analogous constructions in modern cities.



The ancient Venetian sewers, of which this example has been preserved, were useful more than anything else for maintaining, and indeed assisting the circulation of the sea-water in our subsoil. Long centuries have passed, and to us moderns, instead of the primitive methods suggested, we may almost say, by instinct, have been handed down customs consecrated by habit, and of which new experiences suggest the modification.

Some of the Venetian houses now have a separate cesspool, which allows more or less filtration into the surrounding earth; the houses along the canals, on the other hand, make use of these as sewers, and hence result serious inconveniences, partly counteracted by the regulation that their openings shall be below the level of low water, which does not prevent their being completely exposed at the time of the very low tides, together with the accumulations formed here and there at the bottom of the canals, so that at certain times these are canals only in name: "*re vero cloaca fœdissima, quæ sicut turpis et immundissima adspectu, ita pestilens et odore teterrimo.*"[1]

In order to remove these inconveniences I have proposed the abolition of a direct discharge into the canals. "It will suffice to remember the great number of houses provided with separate cesspools (I wrote in the *Gazzetta di Venezia*, on the 31st of May, 1885), in order to ask one's self how it is that other private dwellings, for the sole reason that they are situated on the edge of a public canal, or communicating with it, should arrogate to themselves the privilege of making use of it as their dust-heap or worse. The canals of Venice are not less public than the streets; the same regulation of public cleanliness should therefore prevail for both the former and the latter. Indeed, whatever is thrown or discharged into a canal by private individuals costs the public the additional expense of dredging, while there is also an offence against the public right and the laws of hygiene."

In December last our Municipal Council voted a tax on the drains in proportion to the injury which they cause to the canals, and this encouraged the construction of cesspools, but their construction and emptying yet remain to be regulated. Many things are to be observed with regard to the construction of the cesspools; the worst of their inconveniences is their effect upon the subsoil of a house or a whole city after a length of time, where also air circulates and returns to the surface together with exhalations, where some infectious germs find conditions favorable to their development or reproduction. However great may be the disinfecting action of the ground on which human habitations are standing, like that of cemeteries, after a certain time the agents of reduction become exhausted.

From the purely hygienic point of view, the innocent custom of the fishing population of some of our islands, which throws everything into the canals, where the salt water, a solvent *par excellence* and universal disinfectant, does all the rest, is preferable to the use of cesspools in ground already saturated.

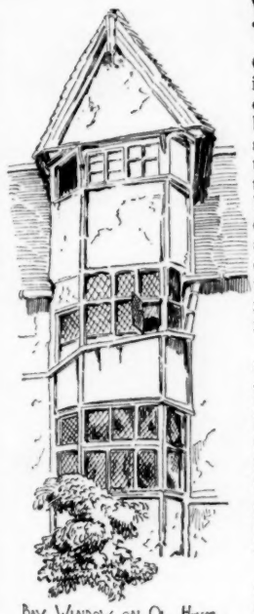
The inconveniences of the cesspools would be removed by making them impermeable, or by surrounding them with a stratum of good earth. In the special case of Venice, where the sea-water itself is a substitute for the earth, we must consider its disinfecting properties and what is its action in filtering through the permeable strata of our subsoil, and how this action may best be utilized for the common good, without meaning in this way to speculate on the cleanliness of our canals. The cesspools which were surrounded by sea-water or by ground in which sea-water freely filtered would act better than those presumedly impermeable.

The ancient sewer of S. Lio contributes to the solution of this problem, recalling how the ancient Venetians, even when treating of islands not large in extent, divided and subdivided the subsoil with artificial drainage, precisely the contrary of that which is often done by the modern ones in filling up the canals with mud and rubbish.

GIACOMO BONI.

[1] Plin. *Sec. ad. Trajan, Imp.*, X, 99.

THE BIRCH.



THE birch coming under our consideration we shift the scene to America, that land of arboreal wonders. Our notice is there fixed, so far as the importance of the wood is concerned, on the *Betula lenta*, otherwise the black birch, cherry birch, Canada birch, sweet birch, or mountain mahogany of the Americans, the *Bouleau merisier* of the French community, and the Quebec birch, etc., of the English merchants. It is a tree of rapid growth, attaining an altitude of seventy or eighty feet, with a diameter of thirty to even thirty-six inches, and a trunk fairly straight, of thirty or even forty feet in length.

It is a native of Canada to Georgia, abounding in Nova Scotia, the district of Maine, and the State of Vermont. It is also plentiful near New York, in Pennsylvania and Maryland. Farther South it ascends the Alleghenies, and is found throughout their whole range, to its termination in Georgia. In loose, cool, deep soil, on the steep, shady banks of mountain rivers, it attains its largest size.

The tree is peculiar in possessing a greyish bark resembling that of the cherry tree, and hence its name of "cherry birch." Its flowers are very fragrant, and its leaves, especially when bruised, emit a sweet odor; this fact has no doubt suggested their use as tea, and the name, as applied to the tree, of "sweet birch."

The wood of this birch is the most valued in the trade. When grown on rich or suitable soil, it is, when newly cut, of a rosy hue, which deepens by exposure, and hence it has taken up the name of mountain mahogany. The grain is fine, close, and capable of a high polish, the wood is hard and strong, fairly durable, and practically free from mechanical disintegration by the action of the worm or furniture beetle. The American birch, although uniformly plain is occasionally figured. In this state it is known as "curled birch," the richest specimens being of sufficient value to warrant their being cut into veneers. Although the birch is bright colored in its dry state, it becomes a dullish brown, a fact that confines its use as an ornamental wood to bedroom furniture.

As a cheap hardwood the birch has, for many years been the staple commodity of the cabinet-maker, and it largely enters into other wood-consuming trades. Forty years ago it was used in the building trade, in a stained form, as a substitute for mahogany; but owing to the uniform cheapness of mahogany at the present time, it has, for this purpose, fallen into disuse. It is imported in logs six feet to twenty feet in length, and twelve to thirty inches square, always with more or less wane; and, occasionally, especially in what is called "low port" shipments, crooked and taper. The Quebec shipments, although the shortest specifications, are the largest squares and the best colored wood. The other shipments, carrying more wane and faults, are uniformly of lighter color. America possesses what appears to us an unlimited supply of this wood, but the cost of transmission in many cases is too great to admit of its being brought to the European market. It is largely used in Massachusetts, Connecticut and New York, where it is next in esteem to the wild cherry.

Another species of the American birch is the *Betula excelsa*, the tall birch, or the yellow birch, the latter name being drawn from the epidermis, or outer layers of bark, being a golden yellow. This tree abounds in the forests of Nova Scotia, New Brunswick, and the district of Maine. It is rare in New Jersey and Pennsylvania, and is confounded with *Betula lenta*, which is abundant there. It is a tree attaining a height of sixty to seventy feet, with a diameter of two feet, and is common to most kinds of soil. The wood is inferior in quality and color. It is, however, strong, and is used for many purposes to which that of *Betula lenta* is applied. In Canada it is used for parts of vessels always under water, for frames of sledges, yokes of cattle, etc. The young saplings are used as hoops for casks, and the wood generally as fuel. Like most of the birch species the bark is used for tanning.

The wood of this yellow birch was formerly imported into Ireland and Scotland in boards and planks, which were used for joinery purposes; but it is now mostly imported in the form of hewn logs, as an ingredient in the common or low port shipments. We must give a passing note to *Betula nigra*, the black birch, or red birch, found in Virginia and North Carolina. The wood of this tree is nearly white, and it is used for purposes to which poplar is generally applied. We cannot hear of its entering into the export trade.

We must close our notice of the great subject of birch by reference to the *Betula papyracea*, of America, otherwise the paper birch, the white birch, or the canoe birch. It is a large tree, a native of the northern districts, notably of the Hudson Bay Territory.

It is a tree of seventy feet in height, with a diameter of three feet, but instances are by no means rare of its attaining double this diameter. The wood is reddish-brown in the heart, and white on the sap, fairly strong, with a fine glossy grain. This tree produces curls in the forks of the branches, which are used by the cabinet-makers of Boston and other Northern towns. Like the birch species in general it forms an excellent fuel; but its wood soon decays where alternations of moisture and heat are present.

AMERICAN BIRCH BARK.

The American continent is far more rich in species and varieties of birch than Europe; but, with one exception, the bark has little or no resemblance thereto. The most valued bark is that of *Betula papyracea*, the great birch of the North, or Hudson Bay Territory. Upon the rising of the vernal sap the bark of this tree is incised in lengths of about twelve feet, trees about three feet in diameter being chosen. Sheets are thus produced twelve feet long and nine feet broad; but for economy in handling they are taken off in two sheets of about four feet each.

The uses to which this fine bark is applied are similar to those common in the North of Europe. It is divided into thin sheets as a substitute for paper; it is used in roofing under shingles, for baskets, boxes, portfolios, soles of shoes, crowns of hats, and as a defence against humidity generally. It lends itself with great freedom to ornament, and is often embroidered with silk, and other fibres of varied colors. It is to the making of canoes and tents that this bark is mainly applied; for these purposes the sheets, selected from large, smooth-barked trees are stitched together with fibrous roots of the white spruce, about the size of a quill; these fibres are barked and rendered supple by steeplng, and the seams, in the case of canoes, are coated with gum from the balm of Gilead fir.

These bark canoes are greatly used by the Indians and French Canadians in making long journeys into the interior, their extreme lightness being a great consideration in carrying from one lake to another. So far as their carrying capacity is concerned, we learn that some of them accommodate fifteen passengers, and that a canoe to carry four persons and their baggage will not weigh above forty or fifty pounds. The "rind tents," made of this useful material, are the admiration of all travellers and hunters in Canada; they are extremely light and portable, and a circular tent twenty feet in diameter and ten feet high can be pitched in half an hour. These tents are used all the year round; but they are the most pleasant in June, July and August.

The import of this remarkable bark has been suggested, and we have no doubt a good trade therein might be done; for as a cheap impervious material, obtainable in large sizes, its use would be manifold. The exhibits of bark canoes in the Colonial Exhibition at South Kensington, London, brings this remarkable material production to our very doors, and offers a splendid reference for those interested in this particular detail of the wood trade. — *The Timber Trades Journal.*

IS MARS INHABITED?

A WRITER in *Chambers' Journal* says:

Some time ago it was observed that situated at each pole of Mars there is a white patch, which increases and decreases at regular intervals. This had been observed for many years before the explanation was suggested by Herschel that it was due to the freezing of the sea, and was exactly analogous to our Arctic and Antarctic Oceans. If this was true the patch of ice would of course decrease in the Martial summer and increase again as the winter came on. This was soon shown to be the fact. Thus we see as far as regards the sea Mars is very similar to our earth, with the exception that the proportion of land is much larger. On the earth the land is only about one-third of the area of the sea; while on Mars, the land and sea surfaces seem to be about equal in extent. The land is much cut up by the water, which exists not so much in the form of a few large oceans, but rather as a number of curious shaped narrow inlets and channels, which intersect the continents in all directions. The bright red color of the land is a curious fact for which no adequate explanation has as yet been suggested. Herschel considered it was due to the peculiar nature of the soil; but it certainly seems curious that in this point Mars should differ from all the other planets. The appearance of the earth seen from a similar distance would probably be a dirty green, or perhaps brown. In fact, on the earth we have no soil or rock, which occurs in any quantity, of the red color which we observe on Mars. There is therefore no vegetation, unless we adopt the curious theory advanced by a French savant that on Mars the foliage is red. Unluckily, we have no instrument that can at all help us here; the telescope and spectroscope are alike useless, and for the present we must content ourselves with vain conjectures.

The next point that ought to engage our attention is the atmosphere, without which no life is possible.

Without entering into calculations, we may state that the pressure of the air at the surface of Mars would be about equal to five inches of mercury, or about one-sixth of the normal atmospheric pressure on the earth.

Now, given an atmosphere and a large extent of sea, we would naturally expect that clouds would form a prominent feature on the Martial surface; and observation has proved this to be the case.

The air on Mars being much less dense than on the earth, it is presumable that the winds would move with much greater velocity; and for this reason it has been thought that trees could not grow to any considerable height. We must, however, bear in mind that, though the velocity would be high, the actual force of the wind would probably not be very great, on account of its excessive tenuity.

In an inquiry as to the probability of the existence of life, one of the most important points to be taken into account is the amount of heat available. Now, Mars is at such a distance from the sun that on the whole it would receive about two-fifths as much solar heat as we do. This does not, however, give the amount of heat that is actually received on the surface of the planet, a considerable proportion being absorbed by the atmosphere; and since our atmosphere is so much denser and thicker than that of Mars, it follows that we lose a much larger percentage of the solar heat. To calculate the exact amount of heat absorbed by a given thickness is a very difficult, if not impossible, problem; but it seems likely that, taking everything into account, the inhabitant of Mars will receive more heat from the sun than we do. This would have the effect of making the evaporation very large, and if so, the Martial atmosphere would be mostly composed of water vapor.

According to Professor Langley, the true color of the sun is blue, and its yellowness is due to the dirt always present in the air. To the inhabitants of Mars, it would most probably appear nearly white, unless, indeed, they also have volcanoes to fill the air with lava dust.

Let me now sum up the facts we have stated, and determine as far as we can what sort of man the inhabitant of Mars must be.

In the first place, the force of gravitation at the surface is only just over one-third of its equivalent on the earth; a pound would therefore weigh about six ounces in Mars. If, therefore, we assume that the men are of such a size that their weight and activity are the same as ours, they would be about fourteen feet high on the average. This would make their strength very great; for not only would it be actually superior to ours, but, as every weight is so much smaller it would be apparently proportionally increased. We should, therefore, expect to find that the Martialites have executed large engineering works; perhaps also their telescopes are much superior to ours, and we have been objects of interest for their observers. With regard to telescopes, it may be interesting to examine what is the effect of the highest magnifying power we can use. At his nearest approach, the distance from us to Mars is about 37,000,000 miles; and assuming that the highest power that can be used with advantage is 1,200, we approach with our telescopes to a distance of 30,000 miles, so that houses or town, or indeed, any artificial works, would be hopelessly invisible. With regard to the supply of heat and light, we have seen that the Martialite is not worse off than we are. To him the sun would appear as a white or perhaps blue disk, about two-thirds of the diameter that it appears to us. The Martial day differs but slightly from ours; his year, however, is much longer, being about 687 of our days, which is about 650 Martial days. The inclination of his axis to the plane of the orbit is such that his seasons would be very similar to ours. It is difficult to reconcile the idea of an extensive vegetation with his peculiar red color; it is just possible, however, that some of the green patches generally supposed to be seas may in reality be large forests.

The most valid objection to the habitability of Mars lies in the fact of the extremely low atmospheric pressure, which, as we have seen, would probably average about five inches of mercury. The lowest pressure that a man has ever lived in, even for a short time, is about seven inches, which was reached by Coxwell and Glaisher in their famous balloon ascent. The aeronauts, however, narrowly escaped perishing, not only on account of the low pressure, but also because of the extreme cold.

It seems impossible that a man constituted exactly as we are could live for any length of time breathing air only one-sixth of the density of ours. But it is rather going out of our way to assume that the Martialites would be exactly the same as we are in every way; the chances are a million to one against it; and on the other hand, a very slight modification of the lung arrangement would suffice to make life perfectly possible under such conditions.

The nights on Mars would be very dark, for he has no satellite like our moon. He has, it is true, two moons, but they are so small that their illuminating power is *nil*, being respectively only sixty and forty miles in diameter. The smallest of these presents the curious phenomenon that it revolves round Mars faster than the planet turns on its own axis, and therefore would appear to rise in the west and set in the east.

Our earth, as seen from Mars when at his nearest, would appear about the same size as Jupiter does to us—that is to say, would subtend an angle of about forty seconds. At his farthest distance, this would be reduced to fourteen.

We thus see that there is ample reason for assuming that this, the most interesting of all the planets, is the abode of creatures not

essentially different from ourselves. Being considerably older than we are, the Martialites are probably much further advanced in the arts and sciences; and perhaps there may be some truth in the story of the Italian astronomer who says he has lately detected lights on the planet moving about in such a way as seems to indicate a deliberate intention to open communication with the earth. What the language of the lights is, we have not been informed; let us hope it is something more practical than the proposal of the Russian savant to communicate with the moon by cutting a huge figure of the forty-seventh proposition of Euclid on the plains of Siberia, which, he said, any fool would understand.

THE PARIS MUNICIPAL LABORATORY.

TOWER OF LE CHÂTEAU D'EAU, FRANCE.

THE Paris Municipal Laboratory is well represented at the exhibition of urban hygiene now open at the Lobau Barracks. The arrangements made allow every one interested to follow minutely the work done and the progress made by this useful institution. The analyses made by the municipal laboratory are, on an average, 16,500 yearly, of which there are 7,000 wine specimens, 4,500 milk. The service includes a *chef*, an assistant *chef*, two principal chemists, twenty-three assistant chemists, twenty inspectors, and four clerks. The hygienic importance of water investigations is now universally admitted. The laboratory practices the biological test in water analyses; this is based upon the culture of microbes in gelatine. These cultivations are made in flat-bottomed, conical glass bottles; two tubes are placed in the cork, one with a glass top and another plugged with cotton wool; the process commences by rendering the bottles sterile in an iron stove capable of resisting two atmospheres, and large enough to contain one hundred and fifty of these receptacles. This stove is exhibited, as well as its vapor generator, which is utilized to distil water for laboratory use; 10c. of gelatine are afterward introduced into the bottles; this is sterilized at a temperature of 150° 110; they are ready for use. At the moment they are required for use, the gelatine is liquefied by means of slight heat, and the water to be tested, diluted with a sufficient quantity of pure water, is poured through the tube provided with a tap. The gelatine solidifies in the process of cooling. The receptacles are arranged in a large metal chest with glass doors, in which the temperature is maintained by means of a thermosiphon. The bacteria develop and give birth to colonies which form as many spots as there are bacteria contained in the volume of water used. Wine is more carefully inspected by the laboratory authorities, and more often tested at the laboratory than any other food substance, in consequence partly from the number of wine-shops in the capital, and partly from the facility with which wine can be adulterated by dishonest tradesmen in order to increase their profits. At the exhibition whoever pleases can witness the series of operations to which the wine analysed is submitted. First, the density is taken by means of a Houdart's oinobarometer; the quantity of alcohol it contains is determined by distillation in an apparatus, in which four wine samples can be tested at the same time by means of an ebullioscope, an instrument founded upon the difference existing between the two forms of boiling water and alcohol diluted with water. At the municipal laboratory department of the urban exhibition there are different models of these instruments; those of M. Malligand, Dr. Perier, and M. Amagat; also a particular kind of pipette, which fills automatically, and serves to measure exactly twenty cubic centimetres of wine, and the different methods of testing which serve to determine the proportion of extract, of ashes, of tartar, of sulphate, and of acid. The proportion of extract is determined in flat-bottomed cylindrical platinum capsules, which are warmed in special water-baths. They are afterwards left to cool in drying cages before being weighed in precision scales. The extract is ascertained by allowing the wine to evaporate in a vacuum obtained by different means. The extract is then incinerated in a large gas-stove (*fourneau à moufle*); the ashes are then weighed. The proportion of sugar is ascertained by Fehling's test. The proportion of acid, tartar, and "*plissage*" are ascertained by reagents of unvarying strength contained in bottles of a special form. Color intensity is determined by Duboscq's chronometer, founded upon the comparison of light which has travelled up to different heights in the fluid. After wine, of which Paris consumes 1,400,000 litres a day, the most important substance is milk, of which the consumption is about 250,000 litres, The different processes of the analyses of milk are exhibited. The density of the milk is first examined by the lactidensimeter, then the cream is allowed to rise, and its height is measured by the creamometer, by means of a pipette analogous to that used for the wine analyses, then ten cubic centimetres of milk are measured and introduced into the flat-bottomed platinum capsules. This milk evaporated at 95° in a hot-air stove, gives the extract, which is weighed and incinerated. A fresh sample of ten cubic centimetres is introduced into one of Marchand's lacti-butyrometers and mixed with pure alcohol. It is then heated in a special water-bath, and the height and quantity of butter which is separated is thus marked, and therefore easily estimated. Preserved vegetables are frequently colored green by using copper. It is not necessary here to discuss the question of their harmlessness.

The municipal laboratory does not only practise chemical methods for solving the many problems submitted to it, it also verifies the purity of alcohols and oils by means of a refractometer which is brought to such a degree of perfection that it determines without calculation, and in a few minutes, the coefficient of the refraction of fluids. The density of coffee and of all groceries is determined by a new volumenometer which is easily used. A special apparatus is used for extracting from the articles of food those substances which are soluble in alcohol and ether. A special kind of spectroscope is used, and a table showing the spectrum of absorption of the principal coloring substances due to the researches of MM. Ch. Girard and Pavot can be consulted. The microscopic preparations of adulterated food preparation are photographed by a magnificent apparatus. Numerous specimens obtained from the archives of the laboratory show that excellent results are arrived at with flour, pepper, vegetable sections, and diatomaces. A part of the exhibition is set aside for apparatus for making gas analyses; amongst them are drying-machines, gas-extractors, for sewage, also several other instruments for estimating the density of gas, either by the quickness with which it escapes, or according to M. Charcot's method.— *Sanitary Record.*

COMMUNICATIONS

[*We cannot pay attention to the demands of correspondents who forget to give their names and addresses as guaranty of good faith.*]

BOOKS ON FRAMING.

CLINTON, MASS., July 27, 1886.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs,— Will you kindly favor me, through the columns of your very valuable paper, with the name and price of some reliable work on modern house-framing, both balloon and full frame? and oblige, Yours very truly, H. F. STIMPSON.

[PERHAPS the book as much to your purpose as any is "*Hatfield's American House Carpenter*," published by John Wiley & Son, New York; price, we believe, $3.00. Tredgold's "*Carpentry*," and Nicholson's "*Joiner's Assistant*" are standard and useful works.—EDS. AMERICAN ARCHITECT.]

H. K. BROWN'S STATUE OF GEN. GREENE.

NEWPORT, R. I., July 27, 1886.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs,— I have just read your notice of H. K. Brown. You have made one mistake, unless I am misinformed. I am quite sure he made the equestrian bronze statue of General Greene in Washington, which seems to me to be the best equestrian statue in America, and *much* the best bronze horse, I know.

Faithfully, GEO. E. WARING.

[IN mentioning the most important of Mr. Brown's works, we were under the impression that the statue of General Greene, mentioned in the records to which we referred for information, was a standing statue within some building, possibly the Capitol. On looking up the matter more closely, we find that Colonel Waring is quite right as to the fact, and fully justified in the opinion he expresses as to the merit of the equine member of the group. Both the horse which bears General Greene, and the one that upholds the ponderous weight of General Scott, are admirable animals, and more like the American saddle-horse of to-day than any other bronze horses in the country. In the case of General Greene's horse, however, we think the sculptor has committed an anachronism, as we do not believe that the horse he bestrides is of his day and time.— EDS. AMERICAN ARCHITECT.]

NOTES AND CLIPPINGS

THE LATE PRINCE TORLONIA.— Visitors to Rome of late years often saw driving in an unpretending carriage, or devoutly attending mass at St. Mark's church, a man of venerable but strange appearance, who, by his aspect seemed to belong to a bygone generation. He might almost have been taken for one of those pensioners who may still be seen in remote almshouses, rare survivors of the energetic reforms of the Charity Commissioners. He was always to be seen dressed in a long snuff-colored coat reaching nearly to his heels, cut after the fashion in vogue in 1820, a large, double-breasted waistcoat, and trousers fitting closely to the leg, but spreading out bell-shaped over the foot. His wristbands, limp and starchless, hung down far beyond the sleeves of his coat, and on his head he wore one of those genuine old beaver hats dear to our grandfathers before the age of silk. In cold weather he was wrapped in a cloak that might well have scandalized the eyes of a modern tailor. It was confidentially affirmed that the owner had worn it for nearly sixty years, ever since he made his first trip to London in 1829. A strange figure this was to meet in the last quarter of the nineteenth century even in Rome, where strange sights are even now common. Yet any one that had an eye to see would have been more struck by the features of the man than by his clothes. The heavy beetling brows, the keen eyes, the square-cut mouth and determined chin could hardly belong to a man without a history. The question, Who is this? was pretty sure to raise to your lips on seeing him, and no passer-by

but could answer the question at once, for Prince Torlonia had, during many years, been a notable character in Rome. He was the chief member of a family whose name had for more than half a century been to Romans a synonym for wealth, luck and liberality. Even the Rothschilds could no more than vie with the Torlonias in their rapid rise from poverty to opulence and their magnificent expenditure of a huge income. The story of that rise can be told in a few words. In 1780, when the Ancien Régime was drawing to a close, two brothers, Marino and Jean Torloni, herdsmen in what is now the department of the Puy-de-Dome, finding life hopeless under the grinding oppression of their noble lord, left their home to seek their fortune in Paris. There they started humbly in business, opening a small shop for the sale of second-hand wares, but by dint of constant attention and of that inflexible economy which is so characteristic of the French peasant, they so prospered that at the end of ten years they were able to make a successful tender for a contract as purveyors to the army of Italy. With that army they reached Rome in 1792, but the hardships of the march proved too much for the elder brother, and he died a few days after entering the city. Jean Torloni, now alone in the world, continued to prosper. With judicious patriotism he supplied the French troops without pressing for immediate payment, and thus won the confidence and esteem of Hugh Basserville, French Ambassador in Rome; so much so that one day, as the tale runs, the Ambassador sending for him, said: "I have here a large sum of gold in my charge which I dare not keep in my own house, for I have a presentiment that I shall soon be assassinated and robbed; I intrust it to you for safe keeping." Torloni took the money, and within a few days Basserville died, as he had forboded, and the money remained as a deposit on trust in the contractor's hands. Torloni, or Torlonia as he was now called, thought himself justified in using temporarily for his own purposes the money that had thus strangely come into his possession, provided that he should in the end restore it, as he subsequently did, to the representatives of the Republic, and opening a bank he was able to conduct operations of considerable magnitude.—*Time.*

How to cool a Cellar.—A great mistake is sometimes made in ventilating cellars and milk-houses. The object of ventilation is to keep the cellars cool and dry, but this object often fails of being accomplished by a common mistake, and instead the cellar is made both warm and damp. A cool place should never be ventilated, unless the air admitted is cooler than the air within, or is at least as cool as that, or a very little warmer. The warmer the air the more moisture it holds in suspension. Necessarily, the cooler the air, the more this moisture is condensed and precipitated. When a cool cellar is aired on a warm day the entering air being in motion appears cool, but as it fills the cellar the cooler air with which it becomes mixed chills it, the moisture is condensed, and dew is deposited on the cold walls, and may often be seen running down them in streams. Then the cellar is damp and soon becomes mouldy. To avoid this the windows should only be opened at night, and late—the last thing before retiring. There is no need to fear that the night air is unhealthful—it is as pure as the air of midday, and is really drier. The cool air enters the apartment during the night, and circulates through it. The windows should be closed before sunrise in the morning, and kept closed and shaded through the day. If the air of the cellar is damp it may be thoroughly dried by placing in it a peck of fresh lime in an open box. A peck of lime will absorb about seven pounds, or more than three quarts of water, and in this way a cellar or milk-room may soon be dried, even in the hottest weather.—*Scientific American.*

Steam-pipes and Woodwork.—Concerning the mooted question of the danger of fire from the contact of steam-pipes with woodwork, the engineer of the City of Quebec writes the *Scientific American* as follows: "I am of opinion, from practical experience, that hot-water pipes in contact with woodwork are dangerous, and I only wonder that insurance companies do not refuse to insure where the necessary precautions are not taken to isolate pipes sufficiently to prevent danger, which, as I shall presently show, it is easy to do. During soft weather steam and hot-water pipes become very hot from the surrounding air being too warm to relieve them of or abstract their heat as colder air does. On one occasion this winter, a very soft day, my steam-boiler had raised the temperature throughout all the pipes about the house to such a scorching heat that everywhere the woodwork was very hot, and I could not bear my hand on any portion of it without burning it as if I held it on a hot stove. It is only two or three weeks ago that a towel laid across the coil in a room on the third floor of a house was actually scorched as if by a red-hot iron, and this has happened more than once. True, water heated under atmospheric pressure only attains to a heat of 212° Fahrenheit or 100° Centigrade; but in a five-story house, even with an open well or cistern in the garret, above a height, say, of fifty feet—equal to a pressure per square inch of nearly twenty-two pounds—the water, of course, reaches a much higher temperature as it does in any closed vessel; and if to this be added the additional pressure or resistance in the rising mains due to the retarding by friction through long stretches of pipe with numerous right-angled bends, it is easy to understand how the temperature required to force the column of water along may be increased so as to become exceedingly dangerous."

The Matapalo or "Tree-killer."—One of the forest curiosities of the Isthmus of Darien and lower Central America is the matapalo or "tree-killer." This starts in life as a climber upon the trunks of large forest trees, and, owing to its marvellously rapid growth, soon reaches the lower branches. It then begins to throw out many shoots, which entwine themselves all around the trunk and branches, and also aerial tendrils which, as soon as they reach the ground, take root. In a few years this gigantic parasite will completely envelop the trunk of the tree which has upheld it and kill it. The whole of the inner dead tree will then rot away, leaving the hollow matapalo standing alone and flourishing.—*Exchange.*

Fireproof Solutions.—Sir F. Abel, F.R.S., invented a silicate of soda which, when applied to wood in the form of a thick syrup, gives considerable resistance to fire. The silicate forms a hard coating, and can be used as follows: The treatment is by painting the wood, first, with a dilute solution of silicate of soda, secondly, with a lime-wash of slaked fat lime colored with mineral ochres or blacks, and, lastly, with a stronger solution of the silicate. The surface of wood should be moderately smooth, and any covering of paper, paint, etc., be removed. A solution of the silicate in the proportion of 1 part by measure of the syrup to 4 parts of water is prepared in a tub or earthen vessel by stirring the measured proportion of the silicate first with a small quantity of the necessary water until a complete mixture is produced, and then adding the remainder of the water in successive quantities until a perfect mixture in the requisite proportions is obtained. The wood is then washed over with this liquid by means of an ordinary whitewash brush, the latter being passed three or four times over the surface, so that the wood may absorb as much of the solution as possible. When this coating is nearly dry the wood is painted with the lime-wash. A solution of the silicate, in the proportion of 1 part by measure of the syrup to 2 parts of water, is then made as above described, and a sufficient time having been allowed to elapse for the wood to become moderately dry, this liquid is applied upon the lime in the manner directed for the first coating.—*Building News.*

TRADE SURVEYS

The slight cessation in midsummer building activity will be followed by a resumption on a probably larger scale. Builders in several large cities have said within ten days that they regard the fall prospects as quite encouraging. Many architects have about completed work on large public buildings, which are to be completed during the season. The building fever will not abate a particle this year, and probably very little next year. The two causes underlying this phenomenal activity are the need of more house room and the need of wider channels for the investment of capital. The abundance of capital will probably continue, although it is always possible to frighten it. Several factors enter into this question. Money can be made suddenly scarce, though successful financial combinations, aided by international understandings as to what shall be regarded as international money. The abundance of money is a constant temptation to the creation of speculative opportunities. Should these opportunities multiply, building enterprise would suffer. A second cause at work is the decreasing returns from building investments. Small houses in large cities pay less than a few years ago, but huge business structures for office use pay better because of the larger amount of office-space made available. These buildings have been springing up in Western cities, and architects state that there are more such large structures in hand, or projected, than ever before. Even in the far West and Northwest where city real estate is not very dear, commercial considerations are leading to the erection of numerous high and compact and architecturally beautiful business palaces.

The country stands upon a non-speculative basis. Never before was it clearer of speculative ventures and artificial values. Never before has capital been as willing for investment. The wreckers who profit by disaster and panic are disappointed at the uniformly favorable returns and indications in all quarters. Vast amounts have been disbursed in the liquidations of mortgage indebtedness, but no doubt new mortgages for as much have been created. Bradstreet's figures gives the value of buildings, for which permits have been issued for six months in twenty-five cities, at $68,000,000, against $53,000,000 in the first half of 1885. It is safe to say that speculative opportunities have been largely and permanently shut off, and the inference is therefore at hand that legitimate enterprise will not hereafter be hampered and sacrificed. The cause which has been so efficacious in bringing about panics has been largely removed by the accumulations of money, and a more thorough understanding of the laws underlying healthful commercial and industrial conditions.

From the above quoted authority it appears that the cost of building operations projected in eleven cities during the first six months of 1886 were $20,853,000, against $22,068,000 for same time of 1885; then the number of projected buildings in thirteen large cities was, in 1886, 15,093; in 1885, 16,319; in 1884, 26,871; in 1883, 24,864, and in 1882, 19,916. This year's investments in New York city are estimated at $75,000,000 in round numbers. Boston's outlay for new buildings for the current year is estimated approximately at $10,000,000, against $13,331,550 for 1885. In Philadelphia for seven months the number of permits taken out foot up 2,349, against 2,217 for first seven months last year, and the number of operations 5,773, against 5,055. Pittsburgh suffers in a reduction from $2,100,000 last year to $700,000 this year. Cleveland repeats last year's record. Columbus drops her building figures from $550,000 for first six months last year to $325,000 this year. Chicago has invested $1,000,000 less this year, but architects and builders say that this deficit will disappear during the year. The new buildings this year number 1,617; cost, $7,395,200. Detroit swells her expenditures $200,000 Louisville makes a gain from $1,225,000 to $1,900,000, and unprecedented activity is reported. Indianapolis falls twenty per cent behind. Kansas City doubles her last year's figures, and will probably erect 3,500 buildings this year at a cost of $6,000,000, St. Paul and Minneapolis show a marked increase. Baltimore permits increased from 1,485 first half of last year to 2,073 this year. Washington fell off nearly half. Richmond holds its own and will show investments this year amounting to about $2,000,000. Charleston and Nashville exhibit very little difference, and Memphis shows a twenty per cent gain.

The industrial and trade conditions elsewhere continue favorable. This year's pig-iron output will reach $6,000,000 tons and the Bessemer steel-rail production has already exceeded all former records at this date. Skelp-iron and wrought-iron pipe were never in greater demand, and the industry generally is expanding with steadiness and safety. Railroad earnings and traffic as compared to former years are improving, resulting in heavier investments in rolling-stock, motive-power and machinery. Commercial exchanges exhibit a slight decline. There is a strong demand for money throughout the West and the supply is sufficient. Manufacturers are daily increasing their capacity and production under the encouraging advices from agents and correspondents. That this year's production will exceed last year's none can doubt, but owing to cost of labor, increased capacity and sharper competition, margins are generally disappointing. The low cost of money on the other hand and the smaller and fewer losses from bad debts are helping traders and manufacturers to bear existing ills with fortitude and patience.